USDA United States Department of Agriculture | Forest Service | Mark Twain National Forest | 401 Fairgrounds Road
Rolla, Missouri 65401
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File Code: 1950
Date: February 16, 2012

Dear Sir or Madam:

Mark Twain National Forest has completed the analysis of a Forest-wide integrated management strategy to control the spread of non-native invasive plant species (NNIP) within the National Forest over the next 10 years; or until circumstances change to the point that the analysis is no longer valid. There are 32 NNIP species currently inventoried and mapped (1,966 sites) which infest approximately 32,428 acres of Mark Twain National Forest.

Enclosed is a copy of the Environmental Impact Statement (EIS) for this project. Three alternatives are analyzed in the EIS. Under Alternative 1, no manual, mechanical, chemical, or biological treatment of existing or future NNIP populations would occur. Alternative 2 (Preferred Alternative) would implement an integrated program for the prevention, suppression, reduction, and eradication of existing and future NNIP infestations on the forest. Control methods would include various combinations of manual, mechanical, chemical, cultural, and biological treatments. Herbicide is proposed on 0.2% of the acres dispersed across Mark Twain National Forest. Alternative 3 would allow only manual, mechanical, and cultural treatments, and limited use of specific biological agents; no herbicides would be allowed.

On February 14, 2012, I signed a Record of Decision (ROD) approving the Integrated Non-native Invasive Plant (NNIP) Control Project. Alternative 2, the selected alternative, authorizes the control of NNIP using a combination of manual, mechanical, biological, and chemical methods. A copy of the ROD is also enclosed.

This decision is subject to appeal pursuant to 36 CFR Part 215. Appeals and any attachments must be filed with the Regional Forester (Appeal Reviewing Officer) within 45 days following the publication of the legal notice in the Rolla Daily News. The publication date of the legal notice in the Rolla Daily News (newspaper of record) is the exclusive means for calculating the time to file an appeal (§ 215.15(a)). Those wishing to appeal should not rely upon dates or timeframe information provided by any other source. Appeals may be mailed to:

Regional Forester Charles Myers
Appeal Deciding Officer
Attn: Appeals & Litigation
USDA-Forest Service, Eastern Region
626 E. Wisconsin Avenue
Milwaukee, WI 53202

Appeals may also be hand-delivered to this address during normal business hours, 7:30 a.m. - 4:00 p.m. CT, Monday-Friday; faxed to: (414) 944-3963, Attn: Appeals & Litigation, USDA-Forest Service, Eastern Region; or submitted via email to: <appeals-eastern-regional-office@fs.fed.us>. Electronic appeals should be in TXT, RTF, DOC, PDF, or other Microsoft Office-compatible formats.

Electronic copies of the Final Environmental Impact Statement (EIS) and ROD for the Integrated NNIP Control Project are available at http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=30341

For additional information, please contact Brian K Davidson at (573) 341-7414.

Sincerely,

DAVID C. WHITTEKIEND
Forest Supervisor

Enclosures (2)

United States
Department of
Agriculture

Forest
Service

February 2012

Final Environmental Impact Statement

Integrated Non-native Invasive Plant Control Project

Mark Twain National Forest lands in portions of Barry, Bollinger, Boone, Butler, Callaway, Carter, Christian, Crawford, Dent, Douglas, Howell, Iron, Laclede, Madison, Oregon, Ozark, Phelps, Pulaski, Reynolds, Ripley, Shannon, Ste. Genevieve, St. Francois, Stone, Taney, Texas, Washington, Wayne, and Wright Counties, Missouri.

Integrated Non-native Invasive Plant Control Project
Final Environmental Impact Statement
Mark Twain National Forest

Lead Agency: **USDA Forest Service**

Cooperating Agencies: **Missouri Department of Conservation**

Responsible Official: **David Whittekiend, Forest Supervisor**
Mark Twain National Forest
401 Fairgrounds Road
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For Information Contact: **Brian Davidson**
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573-341-7414

Abstract: The Mark Twain National Forest proposes a Forest-wide integrated management strategy to control the spread of non-native invasive plant species (NNIP) within the National Forest over the next 10 years, or until circumstances change to the point that the analysis is no longer valid. There are 32 NNIP species currently inventoried and mapped (1,966 sites) which infest approximately 32,428 acres on the Mark Twain National Forest. Three alternatives are analyzed in this EIS. Under alternative 1, no manual, mechanical, chemical, or biological treatment of existing or future NNIP populations would occur. Alternative 2 (Preferred Alternative) would implement an integrated program for the prevention, suppression, reduction, and eradication of existing and future NNIP infestations on the forest. Control methods would include various combinations of manual, mechanical, chemical, cultural, and biological treatments. Herbicide is proposed on 0.2 % of the acres dispersed across the Mark Twain NF. Alternative 3 would allow only manual, mechanical, and cultural treatments, and limited use of specific biological agents. No herbicides would be allowed.

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SUMMARY

INTRODUCTION

This summary provides a concise synopsis of the purpose and contents of the document. The summary stresses the major conclusions, areas of controversy, and the issues to be resolved for the Integrated Non-Native Invasive Plant Control Project.

FOREST PROFILE

The Mark Twain National Forest administers approximately 1,485,800 acres in southern Missouri. This constitutes approximately 10% of the forested land and 84% of the publicly owned forested land in Missouri (Resource Bulletin NC-139).
The Forest is composed of nine separate geographic units in 29 counties which span the state 200 miles east to west and 175 miles north to south. Private land parcels are scattered throughout the Forest boundaries. On average, Federal ownership within the boundaries of the National Forest is about 49%, and ranges from a low of 24% at Cedar Creek unit to a high of 71% at Doniphan/Eleven Point unit.

SUMMARY OF THE FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS)

PURPOSE AND NEED

The purpose of this project is to protect and restore naturally functioning native ecosystems on the Forest by controlling current and future threats of NNIP infestations. Control means, as appropriate, eradicating, suppressing, reducing, or managing NNIP populations, preventing spread of NNIP from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions (Executive Order 13112 invasive species).

Resiliency, integrity, and sustainability of a variety of ecosystems on the Mark Twain National Forest could be compromised if NNIP infestations continue to spread. This action is needed at this time because existing populations of NNIP currently occur on the Forest and are degrading natural communities. Inventoried and new or unknown infestations continue to spread unchecked and threaten native diversity of plants and animals. Past projects to control invasive plants on the Forest have been authorized as small portions of larger vegetation management projects. Those limited actions have not been able to keep pace with the extent to which several NNIP species spread and encroach into new areas. Species such as garlic mustard, spotted knapweed, and Sericea lespedeza are too wide-spread and aggressive to be successfully addressed individually or at a smaller project level.

Due to the scope of the current invasive plant species problem, and in order to be able to treat future infestations more effectively, a broader and more comprehensive approach, with more effective tools, must be developed.

This project also seeks to accomplish the resource goals and objectives of the Mark Twain National Forest as established in the Forest Plan (pg 1-2 and 1-3):

Goal 1.2 – Non-Native Invasive Species

- *Maintain desired ecosystems throughout the forest with few occurrences of non-native invasive species.*
- *Prevent new invasions and control or reduce existing occurrences of non-native invasive species.*

Objective 1.2a

- *Control a minimum of 2,000 acres of existing noxious or non-native invasive species over the plan period.*

DESIRED CONDITION

- The health, diversity, and productivity of native plant communities are not threatened by new and existing NNIP populations.
- NNIP do not adversely affect areas that provide unique biodiversity and wildlife habitat.
- New NNIP populations do not become established within currently un-infested areas.
- New populations of NNIP are not allowed to flourish to the point where controlling the infestations pose a severe management problem.

PROPOSED ACTION

The MTNF proposes to implement an integrated program for NNIP control, which is the prevention, suppression, reduction, and eradication of existing and future NNIP infestations on National Forest System lands within the Mark Twain National Forest boundaries. The integrated approach considers the best available scientific information, most current NNIP inventories, and the effectiveness of control methods in meeting desired treatment objectives. These control methods include various combinations of manual, mechanical, chemical, cultural, and biological treatments. Detailed description of current NNIP inventory, along with proposed treatment priorities, objectives, and methods for each site can be viewed on the Mark Twain National Forest website and are incorporated by reference.

Priorities and treatment considerations for any given NNIP population are based on the species, location, spread potential, treatment objectives, and other factors. Non-native invasive plant populations would be controlled using the following priorities:

Priority 1	Populations of aggressive NNIP species (plant with a fast rate of spread) within prevention areas (springs, seeps, fens, riparian management zones, wilderness, designated State Natural Areas and Management Area (MA) 1.1 and 1.2 and other areas of high quality biological diversity) and aggressive NNIP species outside of prevention areas likely to result in future management problem if not treated in a timely fashion.
Priority 2	NNIP populations adjacent to prevention zones or within specific pathways that facilitate spread of new populations of NNIP into prevention areas.
Priority 3	Populations of NNIP species that do not have an aggressive rate of spread and do not pose a management problem.

Existing and future mapped and inventoried NNIP infestations that are proposed for management activities are assigned a treatment objective of eradication, reduction, or containment. The treatment objectives are defined as follows:

Eradicate	The NNIP is treated to the extent that no viable seed is produced over the entire infestation and all plants have been eliminated during the current field season
Reduce	The infestation is treated to the extent that densities and/or rate of spread are reduced
Contain	Portions of the infestation are treated to prevent spread of the weed beyond the perimeter of the infestation

Other highlights of the proposal include:

- No aerial or large-scale broadcast spraying of herbicides will be permitted under this project.
- Application of chemical or biological treatments will meet or exceed standards and requirements prescribed by all applicable state and federal laws and regulations. This includes adherence to state permitting and licensing requirements for the application of herbicides.
- Most sites will require at least one follow-up treatment in future years, regardless of treatment method.
- Forestwide Standards and Guidelines (Appendix B) and Project Design Features (Chapter 2) will be applied.

Additionally, new infestations will be inventoried, monitored, and evaluated to determine if they can be controlled using this strategy developed. NNIP occurrences would be treated as they arise or are discovered on the Forest, without initiating a new analysis each time. This would allow the Forest Service to control new infestations more quickly and efficiently. Treatment methods that do not conform to the strategy established would require a separate analysis process. For example, prescribed burning to treat NNIP in designated wilderness areas is not analyzed as part of this project, so a separate analysis, including public involvement, would be initiated if new infestations requiring prescribed fire in these areas were proposed.

Numerous mitigation measures have been developed to minimize effects of the proposal. For a listing of the Design Criteria, and more details on the Proposed Action, please see Alternative 2 in Chapter 2 of this document and the Mark Twain National Forest website.

ISSUES

Key Issues: The Forest Service identified the following key issues during project design and IDT interaction:

Issue A: Treatment of non-native invasive plants could inadvertently impact non-target species. Herbicides could move offsite and affect non-target species and physical resources (i.e. water and soils). The type of herbicide, method of application, and the environment in which the herbicide is applied are all factors that influence whether or not herbicides move offsite.

> ***Measure:*** *Qualitative ratings of the overall potential for leaching, solution runoff, and adsorbed runoff based on chemical and physical properties of all proposed herbicides and soils.*

Issue B: The use of three bio-agents proposed for the control of spotted knapweed. They include a root weevil (*Cyphocleonus achates),* and two seed head weevils (*Larinus minutus, Larinus obtusus.*) The Missouri Departments of Conservation and Transportation have approval from the USDA - Animal and Plant Health Inspection Service (APHIS) and have been using these bio-agents on State lands adjacent to the MTNF since 2008. There has been no analysis of the effects on non-target plant species within the State of Missouri.

> ***Measure:*** *The number of potential release sites of root weevil and seed head weevils for spotted knapweed populations adjacent to native plants of concern, such as Centaurea Americana.*

Issue C: The Forest will not be able to eradicate or reduce certain NNIP populations without the use of herbicides.

> ***Measure:*** *The approximate number of acres that known mapped and inventoried NNIP populations would be eradicated or reduced with the use of herbicides.*

ALTERNATIVES CONSIDERED

ALTERNATIVE 1 – NO ACTION

Under this alternative, the Forest Service would not implement the activities listed in the proposed action or any other action alternative considered for this project at this time on the MTNF. There would still be some NNIP control on the MTNF based on past project decisions, and NNIP control would continue to be considered in future project decisions.

Education and prevention efforts on the MTNF would continue. Inventory and mapping of NNIP infestations would also continue.

ALTERNATIVE 2 – THE PROPOSED ACTION

Each mapped and inventoried NNIP infestation on the MTNF is assigned a treatment objective to eradicate, reduce, or contain the infestation. The proposed action is designed to achieve these objectives through an integrated NNIP management program on the Forest. The proposed action would involve one or a combination of management approaches including manual, mechanical, biological, and chemical control methods. A document titled "Treatment Methods – Preferred Alternative" displays the site specific actions proposed, or "treatment methods," for each inventoried site, and is available on the Mark Twain National Forest website http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=30341. This 36-page document is summarized in Table 2 and hereby incorporated by reference.

The following 5 – Step process is followed determining and implementing NNIP treatments

1. **Identify and prioritize species/infestations**
    - **Priority 1** - Populations of aggressive NNIP species within prevention areas In addition, aggressive NNIP species outside of prevention areas likely to result in future management problem if not treated in a timely fashion.
    - **Priority 2** - NNIP populations adjacent to prevention zones or within specific pathways that facilitate spread of new populations of NNIP into prevention areas.
    - **Priority 3** - Populations of NNIP species that do not have an aggressive rate of spread and do not pose a significant management problem.
2. **Determine treatment objective**
    - **Eradicate** - Treat to the extent that no viable seed is produced over the entire infestation and all plants have been eliminate during current field season.
    - **Reduce** - The infestation is treated to the extent that densities and/or rate of spread are reduced.
    - **Contain** - Portions of the infestation are treated to prevent spread of the weed beyond the perimeter of the infestation.
3. **Determine the most economical and effective treatment**

    Refer to the document "Mark Twain National Forest Non-native Invasive Plant Treatment Methods" for the most up-to-date information for treating each type of NNIP. The choice of treatment methods takes into account the following factors:
    - Species and size of infestation
    - Relationship to the site to other infestations
    - Accessibility
    - Relationship of the site to federally listed species and species of concern
    - Distance to surface and ground water resources
    - Exposure to public

- Effectiveness of treatment on target weed
- Cost

4. **Implement according to MTNF Forest Plan Standard and Guidelines and Project design criteria**
    - Check Soil/Herbicide Interaction ratings for treatment site to determine if herbicides would be safe for use.
    - If herbicides are proposed for treatment, complete herbicide -use proposal (FS-2100-2) and have approved by District Ranger and Forest/Regional Herbicide Coordinator.
    - If new or unmapped infestations require treatment objectives or methods not analyzed in this EIS, new NEPA analysis would be conducted.
5. **Monitor for Effectiveness**
    - Evaluate treatment and determine if objectives are being met. If objective are not being met adjust treatment strategies.

Table 2 (page XX) shows treatment objectives and recommended methods of treatment for the current inventoried NNIP infestations. The treatment objectives and methods are not static and subject to change based on factors mentioned above, e.g., once an infestation is reduced to a manageable size, a decision to eradicate the infestation can be made. Unmapped NNIP infestations would be treated similarly with regard to treatment objectives. If new or unmapped infestations require methods not analyzed in this EIS, new NEPA analysis would be conducted.

Treatment Methods

Treatment of NNIP sites will employ a wide-range of techniques which include manual, mechanical, cultural, chemical, and biological treatments. Appendix C provides a more in depth discussion of the implementation of these treatment methods. In addition, a document titled MTNF NNIP Treatment protocol is available at: Mark Twain National Forest – Projects.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

This alternative would allow control of NNIP populations by utilizing manual, mechanical, biological, or cultural treatment methods only. No use of herbicides would be authorized. The use of three biological agents proposed in Alternative 2, root weevil and seed head weevils would not be authorized. The remaining biological agents would be allowed. This alternative was developed in response to concerns related to unintended consequences from the use of herbicides and uncertainties about the release of root and seed head weevils. A document titled "Treatment Methods –Alternative 3" displays the site specific actions proposed, treatment methods and objectives, for each inventoried site, and is available on the Mark Twain National Forest website http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=30341. This 36-page document is summarized in Table 3 and hereby incorporated by reference.

COMPARISON OF ALTERNATIVES

Objective or Issue	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3 (No Herbicides, limited biocontrol)
Objective: Protect and restore native ecosystems	NNIP will continue to spread, with adverse impacts on natural communities, TES, etc.	Beneficial effect; 72% of NNIP would be targeted for eradication or reduction. Move toward restoring natural communities.	Beneficial effect; 6% of NNIP would be targeted for eradication or reduction. Most (94%) NNIP treatment objectives in "control" Less movement toward restoring natural communities
Objective*:* Reduce or eliminate NNIP sites	No NNIP sites would be reduced or eliminated through this decision	Eradicate 8%; Reduce 64%	Eradicate < 0.03%; Reduce 6%
Issue A: Herbicides could move offsite and affect non-target species and physical resources	No effects	Limited, localized, short-term effects; no cumulative effects	No effects
Issue B: Biological controls could have unintended effects to non-target plant species and the biological environment – Measure #of potential release sites near Centaurea Americana	No effects	Of the 34 potential release sites, there are no known populations of *Centaurea Americana*	No adverse effects
Issue C: Ability to eradicate certain NNIP populations without the use of herbicides	Not applicable	Eradicate 2,447 ac Reduce 20,953 ac	Eradicate 9 ac Reduce 1,922 ac
Forest Plan Consistency	Not applicable	All actions are consistent with the Forest Plan	All actions are consistent with the Forest Plan

RESPONSE TO ISSUE A

Herbicides are used to control or eradicate unwanted vegetation. It is desirable for the chemicals to remain in the soil long enough to control weeds, but not so long that it becomes a pollutant. The amount of time that an herbicide remains active in the soil is known as persistence. Many factors determine the length of time herbicides persist in soil; most factors fall into three categories: soil factors, climatic conditions, and herbicide chemical properties.

Soil factors affecting herbicide persistence include the physical, chemical, and microbial properties. Soil composition is a factor that measures soil texture and soil organic matter. Chemical properties of the soil include pH, cation exchange capacity (CEC), and nutrient status. Soil composition affects herbicide phytotoxicity and persistence through adsorption, leaching, and volatilization (Hager et al. 1999). Generally, soils high in clay or organic matter have a greater potential for herbicide persistence because there is increased binding with soil particles, with a corresponding decrease in leaching and loss through volatilization.

Some herbicides are affected by soil pH, an important part of the soil chemical makeup. Chemicals do not readily adsorb soil particles at higher soil pH, so they remain in the soil solution. Herbicides in the soil solution could then leach through the soil profile and move offsite. Chemical breakdown and microbial breakdown, two major herbicide degradation processes, are often slower in soils of higher pH. So although decreased adsorption of herbicides occurs in soils of higher pH, there would also be less degradation.

Degradation by soil microorganisms depend on the type and abundance of the soil microbes present. Soil microorganisms are partially responsible for the breakdown of many herbicides. The types of microorganisms and their relative amounts determine how quickly decomposition occurs. Soil microbes require certain environmental conditions for optimal growth and breakdown of any herbicide. Factors that affect microbial activity are temperature, pH, oxygen, and mineral nutrient supply. Usually, warm, well aerated, fertile soil with a medium soil pH is most favorable for micro-organisms and hence herbicide breakdown.

The climatic conditions influencing herbicide degradation are soil moisture, temperature, and sunlight. Herbicides degrade more rapidly as temperature and moisture increases due to higher chemical and microbial decomposition rates (Hager et al. 1999). Cool or dry conditions slow degradation, which could increase herbicide persistence. If winter and spring conditions are wet and mild, herbicide persistence is less likely. Sunlight plays a role in herbicide degradation as well; herbicides may be lost when applied to the soil surface and remain there for an extended time period without rainfall. Therefore, degradation is accelerated on very sunny days.

The chemical properties of an herbicide can also affect its persistence. Important factors include water solubility and susceptibility to chemical and microbial degradation. The solubility of an herbicide influences its leaching potential; leaching occurs when an herbicide is dissolved in water and moves down through the soil profile. Highly soluble herbicides may be carried to rooting zones of susceptible plants, or be moved offsite. Herbicide leaching is determined by both the herbicide’s water solubility and its ability to bind to soil particles. Herbicides exhibiting low solubility are held strongly to soil particles, in addition, herbicides that exist in dry soils are less likely to leach and have a greater potential to persist.

The capacity of the soil to filter, buffer, degrade, immobilize, and detoxify herbicides is a function or quality of the soil. Soil quality also encompasses the impacts that soil use and management can have on water and air quality, and on human and animal health. The presence and bioavailability of herbicides in soil can adversely impact human and animal health, and beneficial plants and soil organisms. Herbicides can move off-site contaminating surface and groundwater and possibly causing adverse impacts on aquatic ecosystems.

Herbicide stays in the treated area long enough to produce the desired effect and then degrades into harmless materials. Three primary modes of degradation occur in soils:

- biological - breakdown by micro-organisms
- chemical - breakdown by chemical reactions, such as hydrolysis and redox reactions
- photochemical - breakdown by ultraviolet or visible light

The rate at which a chemical degrades is expressed as the half-life. The half-life is the amount of time it takes for half of the herbicide to be converted into something else, or its concentration is half of its initial level. The half-life of an herbicide depends on soil type, its formulation, and environmental conditions (e.g., temperature, moisture). Other processes that influence the fate of the chemical include plant uptake, soil sorption, leaching, and volatilization. If herbicides move off-site (e.g., wind drift, runoff, leaching), they are considered to be pollutants. The potential for herbicides to move off-site depends on the chemical properties and formulation of the herbicide, soil properties, rate and method of application, herbicide persistence, frequency and timing of rainfall or irrigation, and depth to ground water.

Most infested sites would receive foliar applied spot treatments, in an effort to limit the amount of herbicide sprayed directly on the ground. Large infestations in fields and along right of ways may receive foliar applied broadcast treatments with boom sprayers. Broadcast application will increase the herbicide loss potential on some sites. However, herbicides that do come in direct contact with the soil would leave some level of residue until it is degraded.

Once in contact with the soil, herbicides can persist until degraded by sunlight, water or microorganisms; and/or move offsite by leaching or surface runoff. Soil physical and chemical properties will influence how water infiltrates the surface and moves throughout the soil profile. The capacity of herbicides to accumulate in soil is controlled by the chemical formulation as well as soil and climatic factors (Hager et al. 1999).

Analysis of soil-herbicide interaction used WIN-PST3. This is a screening tool developed by the NRCS to evaluate overall potential for a specific herbicide to leach or runoff, based on properties of individual soils. Herbicide values considered are solubility, half-life, human toxicity, and fish toxicity. Soil factors such as slope > 15%, high water table within 24 inches of the surface during the growing season, presence of macrospores in the surface horizon deeper than 24 inches, texture of surface horizon, hydrologic soil group, Kfactor (erosion potential of surface horizon and its thickness), and organic matter percent of surface horizon are also considered. WIN-PST3 matches the selected herbicide and soil and returns ratings for potential for leaching, solution runoff, and adsorbed runoff ratings. The matrixes for soil/herbicide interactions can be found in Appendix D. WIN-PST3 reports for this project's herbicide and soils can be found at: http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=30341

The herbicides evaluated with WIN-PST for Alternative 2 indicated a very low to intermediate loss potential for foliar spot and broadcast application with standard application rates under a high rainfall climate. All spot applications were rated low to very low. No method rated high or very high. It is unlikely that chemicals applied to control NNIP would move offsite.

Based on the information presented additional design criteria have been developed to minimize the potential for adverse direct and indirect effects to Watershed Condition:

- The use of highly mobile herbicides shall be avoided on soils with highly leachable properties where the Soil – Herbicide Interaction, Leaching, Solution Runoff, and Adsorbed Runoff Potential is rated high or extra high. For soils with an intermediate rating, a field visit by the Forest Soil Scientist must be made prior to application.
- No herbicides will be used within any fen (the fen proper) or connected drainage feature known to be occupied by Hine's emerald dragonfly larvae or adults unless a "wicking method" is approved by FWS and FS hydrologist.
- Unless approved by the USFWS and Forest Service hydrologist, no endothall or triclopyr will be used within fens known to contain Hine’s emerald dragonfly larvae or adults or the fen buffer area. The fen buffer area is defined in the Forest Plan (p 2-13) as 0.5 mile upstream of the fen and 300 feet on the lateral sides of perennial streams that may feed into that fen within 0.5 miles upstream.
- No application of herbicides will occur in the Tumbling Creek cavesnail recharge area within 72 hours prior to expected precipitation.
- Aquatic herbicides will only be applied to man-made impounded waters, i.e. lakes and ponds.

The goal of the above design criteria was minimize adverse direct and indirect effects to RMZs, WPZs, fens, caves, springs, and sinkholes and protect karst terrain. Product label restrictions minimize the potential direct effect to ephemeral stream channels and associated aquatic habitat. Site specific situations where adverse localized direct and indirect effects might occur include:

- An ephemeral channel surface and subsurface hydrologically connection to fen recharge outside of the protected fen designation
- A forest road with ephemeral stream crossings, where the ditch is hydrologically connected to an ephemeral stream. This situation is very common, and length of hydrological connection is variable.

Potential adverse direct and indirect effects to the Watershed Condition are not quantifiable but are expected to occur only in the vicinity of the herbicide application. Duration of the adverse effect is dependent on the concentration and half-life of the herbicide and timing of a precipitation event post application.

RESPONSE TO ISSUE B

In the current NNIP inventory, there are 23 sites of spotted knapweed with an average infestation size of 34 acres, where seedhead and root weevil are identified as possible suitable sites for release. Most of these proposed sites are located in counties that University of Missouri Extension, MDOT and MDC have already completed releases (http://extension.missouri.edu/webster/spottedknapweed/).

Based on the host testing, extensive use in the past 30 years in the western states and more recent use in the upper Midwest in the past 10 years it is not likely that release of these biological control agents would have a significant impact on populations of native *Centaurea* or *Cirsium* species within the State. However, once a biological control agent is released into the environment and becomes established, there is a slight possibility that it could move from the target plant to attack nontarget plants, such as the native plant *Centaurea americana*. Host shifts by introduced weed biological control agents to unrelated plants are rare (Pemberton, 2000).

The IDT was concerned about the unintended consequences on non-target species by releasing two weevils (*Larinus minutus/obtusus*) and root borer weevils (*Cyphocleonous achates*) that are host-specific to the spotted knapweed. Biological control of spotted knapweed in Missouri, begun in 2008 and involved the release of seedhead weevils at over 200 sites in Missouri. These releases were made by the Missouri Department of Transportation, Missouri Department of Conservation, and University of Missouri Extension. It will take several years for populations of these insects to grow enough to begin providing significant control of the spotted knapweed.

In Montana, Washington, uses of seedhead weevils and root borer weevils have been used as a bioagent for knapweed for over thirty years. No documented occurrence of these agents impacting native species has been documented. However, no monitoring studies geared at investigating the environmental impact of the releases were found during literature searches. The only studies found were effectiveness studies (i.e., were the weevils effective in controlling the target species). Releases of these biological control agents have also been made in Michigan, Minnesota, and Wisconsin within the last twenty years.

In Minnesota, the USDA released eleven biocontrol agent species in the state from 1989 through 2000 to manage this spotted knapweed. This included the seedhead and root borer weevils, which now, have well established population in the state. A study conducted from 2003-05 of Minnesota knapweed biocontrol sites showed a highest level of control when using the seed feeding weevils *Larinus minutes* and *L. obtusus* in combination with the root-feeding weevil, *Cyphocleonus achates*. There also has been no documented impact to non-target species in the state. However, as mentioned above, no monitoring studies investigating non-target effects were found.

In Missouri, there is only one native knapweed, American basket flower (*Centaurea americana*) that in the same genius as Spotted knapweed. The Missouri Department of Conservation list the American basket flower as a occurring historically in the state (Mo. Species and Communities of Conservation Concern 2011). There are no known populations of this species on the MTNF but there may likely be scattered individual plants on the MTNF. Both the seedhead weevils and the root borer weevils prefer large relatively dense populations of knapweeds. Other biological control species have been known to switch hosts especially within the same or closely related genera (Louda et al 1997), and it is not known whether the biological control agents proposed will switch to the native knapweed if released nearby.

Alternative 2 proposes to treat 34 populations of spotted knapweed, totaling 438 acres, with biological control agents. There are no known instances of American basket flower at those sites, or anywhere else on the MTNF. It is unlikely that release of the weevils would impact American basket flower.

Although most of these species are very host-specific, the leafy spurge beetles are known to occur on non-target plant species (Louda et al 1997). The beetles target plants in the sub-genus *Esula,* which has three native species in Missouri, none of which are federally, regionally or state listed. It is possible that these beetles might feed on non-target plants of the sub-genus *Esula*. While this would damage and possibly kill some plants, it is unlikely there would be any impact on local or regional populations of any of these three *Esula* species, due to their common occurrence in the state.

Design criteria have been developed to reduce the potential impacts of the release of biological control agents (TES7).

As noted for vegetation, the proposed biological agents have been demonstrated through research to adversely affect only the targeted NNIP species and other closely related taxa, with the few exceptions noted above. It is therefore unlikely that native plants upon which wildlife depends for food or cover would be adversely affected. Indigenous wildlife like the MIS noted above is generally adapted to depend upon regionally indigenous plant species as sources of food and cover. Plants introduced from other parts of the world, while typically beneficial to wildlife in that part of the world, are normally of less value to wildlife in the areas of introduction. For example, grazing animals avoid musk thistle because of its thorny leaves and stem (Jennings et al. ND). Introductions of biological control agents targeting musk thistle would therefore be expected to reduce dominance of musk thistle, creating areas dominated by native plants, which are of greater value as food and cover for wildlife. However, it is possible that some NNIP or even previously released biological control agents that have become established in an area may have displaced the ecological function of the native vegetation or insects (i.e., salt cedar in the southwestern US became habitat for the endangered southwestern willow flycatcher after it replaced the native willows the birds depended on – removing the salt cedar would cause long-term displacement of the birds until native willows were reestablished) (Pearson and Callaway 2003). There are no known such cases on the MTNF; however, this has not been studied either.

Since most of the biological controls are insects, it is possible that any of the five MIS or associated Neotropical migratory birds could consume some of the released insects. What impact this would have on an individual or species is unknown. Food-web interactions have just begun to be documented (Pearson and Callaway 2003). They noted studies that linked release of gallflies (*Urophora* spp.) for spotted knapweed control, led to increases in deer mice populations whose populations used to be limited by food availability. Studies documenting this type of food-web interaction have not been found for any of the species the MTNF is proposing to use.

Under Alternative 3, since root weevils (*Cyphocleonus achates*) or seed head weevils (*Larinus minutus, Larinus obtusus*) would not be released in this alternative, there would be no impacts to non-target species such as the American basket flower.

It is anticipated that the proposed control methods described in Alternative 3 would result in reduction or eradication of NNIP species within treated areas, but perhaps not as completely or effectively as Alternative 2, since some NNIP would be difficult if not impossible to control without the use of herbicides.

RESPONSE TO ISSUE C

In regard to Issue C, there is a concern about the Forest's ability to eradicate certain NNIP populations without the use of herbicides. Under Alternative 2, herbicide use is identified as a suitable method treatment on roughly 3,652 acres of infestation. This represents approximately 11% of the mapped and inventoried infestations. With the use of herbicides in combination with manual and mechanical treatments in Alternative 2, the ability to achieve eradication or reduction objectives on more acres of NNIP infestations would have a higher percentage of success. For Alternative 2, a treatment objective of eradication has been assigned on about 2,447 acres (8%) of existing NNIP populations. Herbicide use is identified as a treatment method to eradicate these populations.

All newly discovered infestation that are detected early enough and are relatively small (< 1 acre) in size would be rapidly targeted for eradication, especially if those infestation that are highly invasive, are a threat to native plant communities and specialist habitats, and can easily and economically be eradicated. In most cases, this would involve an integrated use of manual, mechanical and herbicide treatments.

Alternative 3 forgoes the use of herbicides thus reducing the amount of NNIP infestations eradicated by 2,438 acres. Without the use of herbicide, only 9 acres could be eradicated without herbicides. Approximately 30,497 acres (94%) would be placed in a containment strategy compared to Alternative 2, which would be 9,028 acres (27%). The ability to reduce NNIP infestations effectively would go from 1,922 acres (6%) in Alternative 3 to 20,953 acres (65%) in Alternative 2.

Controlling NNIP infestation in Alternative 3 would not be nearly as effective as Alternative 2. Effective eradication of newly discovered infestations is likely to be compromised without the use of herbicide. In addition, Alternative 3 has an opportunity cost by requiring the Forest to focus limited resources on containment strategies year after year rather than focusing on eradication efforts.

CHAPTER 1 PURPOSE OF AND NEED FOR ACTION

DOCUMENT STRUCTURE

The Forest Service has prepared this Final Environmental Impact Statement in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Impact Statement discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* This chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by specific resource areas.
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies consulted during the development of the environmental impact statement.
- *Appendices:* The appendices provide more detailed information to support the analyses presented in the environmental impact statement.

Additional documentation, including more detailed analyses of project-area resources, may be found on the Mark Twain National Forest (MTNF) website and in the project planning record located at the MTNF Supervisor's Office.

BACKGROUND

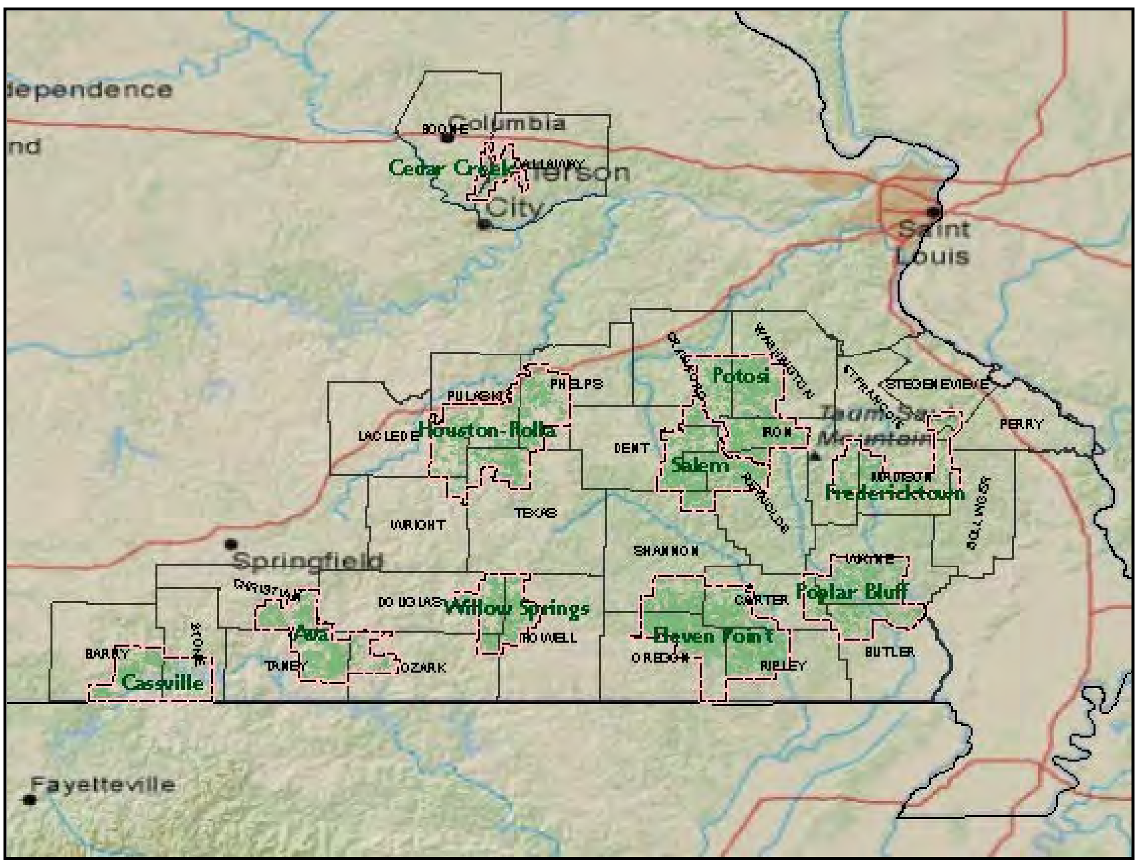
In 2003, the threat posed by invasive plant species prompted the Chief of the Forest Service to include invasive species as one of the Four Threats to the Health of the Nation's Forests and Grasslands. The spread of non-native invasive plant (NNIP) species directly threatens the health of native ecosystems. These plants have characteristics that permit them to rapidly invade and dominate in new areas, often out-competing native plants for light, moisture, and nutrients. NNIP are generally most abundant in regularly disturbed areas, such as roadsides, and in old fields.

We conducted an analysis of NNIP control and documented it in an Environmental Assessment finalized in early 2009. The NNIP control Decision Notice was administratively appealed and subsequently withdrawn in July 2009. We initiated a new project planning analysis for integrated NNIP control with a scoping proposal in November 2009, building on the previous analysis. Three new chemicals and two biological agents have been added to the suite of proposed treatments. Also, the Missouri Department of Conservation has joined with the MTNF as a cooperating agency. Initial environmental analyses indicated that adding the chemicals and biological agents increased the scope and complexity of the project. The Forest Supervisor determined that an environmental impact statement was the most appropriate NEPA analysis for this project.

LOCATION

The affected areas are all Mark Twain National Forest lands susceptible to infestation by NNIP. The majority of the affected area lies in the southern half of Missouri, including portions of Barry, Bollinger, Butler, Carter, Christian, Crawford, Dent, Douglas, Howell, Iron, Laclede, Madison, Oregon, Ozark, Phelps, Pulaski, Reynolds, Ripley, Shannon, Ste. Genevieve, St. Francois, Stone, Taney, Texas, Washington, Wayne, and Wright Counties, Missouri. There is also a small amount of area in the Cedar Creek Unit, which lies just north of the Missouri River in Boone and Callaway Counties. The administrative boundaries of the MTNF encompass 3,108,818 acres and include tracts of National Forest System land totaling 1,497,847 acres.

Figure 1 Location of the Mark Twain National Forest



PURPOSE AND NEED FOR ACTION

The purpose of this project is to protect and restore naturally functioning native ecosystems on the Forest by controlling current and future threats of NNIP infestations. Control means, as appropriate, eradicating, suppressing, reducing, or managing NNIP populations, preventing spread of NNIP from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions (Executive Order 13112 invasive species).

Resiliency, integrity, and sustainability of a variety of ecosystems on the Mark Twain National Forest could be compromised if NNIP infestations continue to spread. This action is needed at this time because existing populations of NNIP currently occur on the Forest and are degrading natural communities. Inventoried and new or unknown infestations continue to spread unchecked and threaten native diversity of plants and animals. Past projects to control invasive plants on the Forest have been authorized as small portions of larger vegetation management projects. Those limited actions have not been able to keep pace with the extent to which several NNIP species spread and encroach into new areas. Species such as garlic mustard, spotted knapweed, and Sericea lespedeza are too wide-spread and aggressive to be successfully addressed individually or at a smaller project level.

Due to the scope of the current invasive plant species problem, and in order to be able to treat future infestations more effectively, a broader and more comprehensive approach, with more effective tools, must be developed.

This project also seeks to accomplish the resource goals and objectives of the Mark Twain National Forest as established in the Forest Plan (pg 1-2 and 1-3):

Goal 1.2 – Non-Native Invasive Species

- *Maintain desired ecosystems throughout the forest with few occurrences of non-native invasive species.*
- *Prevent new invasions and control or reduce existing occurrences of non-native invasive species.*

Objective 1.2a

- *Control a minimum of 2,000 acres of existing noxious or non-native invasive species over the plan period.*

DESIRED CONDITION

- The health, diversity, and productivity of native plant communities are not threatened by new and existing NNIP populations.
- NNIP do not adversely affect areas that provide unique biodiversity and wildlife habitat.
- New NNIP populations do not become established within currently un-infested areas.
- New populations of NNIP are not allowed to flourish to the point where controlling the infestations pose a severe management problem.

EXISTING CONDITION

The Forest Service has used all known NNIP inventories and site observations, together with regional invasive plant information, to develop a list of NNIP species that occur on the Mark Twain National Forest. There are 32 NNIP species currently inventoried and mapped (1,966 sites) infesting approximately 32,430 acres on the Forest. An additional nine species occur within the state of Missouri and have the potential to occur on the MTNF within the next ten years, if they do not already. A detailed list and information for these species is available in

Appendix A. More information, including a document titled MTNF NNIP Treatment protocol is available at: [Mark Twain National Forest – Projects.]

Throughout the MTNF, NNIP are most abundant in regularly disturbed areas such as roadsides and old fields. The most pervasive NNIP species on the MTNF is Sericea lespedeza (*Lespedeza cuneata)* with 891 mapped and inventoried populations, totaling 14,344 acres. This species is highly invasive and may invade non-shaded, disturbed areas such as open woodlands, glades, pasturelands, and roadsides. Individual stems may produce thousands of seeds, with millions of seed produced per acre. Mature seeds of this genus can remain viable for up to twenty years. However, Sericea lespedeza is not the greatest threat to plant and animal community diversity on the Mark Twain. NNIP species such as Amur honeysuckle, garlic mustard, Japanese stiltgrass, and spotted knapweed are presently a greater ecological impact to Missouri natural communities (NatureServe 2010).

The most effective, economical, and ecologically sound approach to managing invasive plants is to prevent their invasion in the first place. The Forest proposes to manage all infestations forest-wide to limit the spread of invasive plants into non-infested areas. Our limited resources require more efficient and proactive weed management that not only controls existing NNIP infestations but also focuses strongly on prevention or early detection of new invasions. The MTNF has prioritized "prevention areas" where limited resources should be applied first. These prevention areas, encompassing approximately 825,000 acres, are comprised of recreation areas, glades, springs, seeps, fens, riparian management zones, wilderness, Management Areas (MA) 1.1, 1.2, and 8.1, and other areas of high quality biological diversity. The current NNIP inventory identifies approximately 12,000 acres of weed infestations within prevention areas. These infestations are top priority for treatment because they pose the greatest threat to natural plant communities, sensitive wildlife habitats, and recreational use on the Forest.

NNIP control activities on the MTNF have been performed almost entirely by manual and mechanical means (i.e., mowing, hand pulling, digging, and cutting). The use of herbicides to control NNIP has declined dramatically from a high of 602 acres treated in 1995, to virtually none in 2006 through 2009. Almost 300 acres were treated in 2010. The majority of NNIP treatments succeeded in containment only. Monitoring indicates infestations of NNIP populations continue to grow and spread at an accelerating rate. Effective control of NNIP infestations is extremely difficult, if not impossible, without an integrated system that includes the use of herbicides and biological agents.

PROPOSED ACTION

The MTNF proposes to implement an integrated program for NNIP control, which is the prevention, suppression, reduction, and eradication of existing and future NNIP infestations on National Forest System lands within the Mark Twain National Forest boundaries. The integrated approach considers the best available scientific information, most current NNIP inventories, and the effectiveness of control methods in meeting desired treatment objectives. These control methods include various combinations of manual, mechanical, chemical, cultural, and biological treatments. Detailed description of current NNIP inventory, along with proposed treatment priorities, objectives, and methods for each site can be viewed on the Mark Twain National Forest website and are incorporated by reference.

Priorities and treatment considerations for any given NNIP population are based on the species, location, spread potential, treatment objectives, and other factors. Non-native invasive plant populations would be controlled using the following priorities:

Priority 1	Populations of aggressive NNIP species (plant with a fast rate of spread) within prevention areas (springs, seeps, fens, riparian management zones, wilderness, designated State Natural Areas and Management Area (MA) 1.1 and 1.2 and other areas of high quality biological diversity) and aggressive NNIP species outside of prevention areas likely to result in future management problem if not treated in a timely fashion.
Priority 2	NNIP populations adjacent to prevention zones or within specific pathways that facilitate spread of new populations of NNIP into prevention areas.
Priority 3	Populations of NNIP species that do not have an aggressive rate of spread and do not pose a management problem.

Existing and future mapped and inventoried NNIP infestations that are proposed for management activities are assigned a treatment objective of eradication, reduction, or containment. The treatment objectives are defined as follows:

Eradicate	The NNIP is treated to the extent that no viable seed is produced over the entire infestation and all plants have been eliminated during the current field season
Reduce	The infestation is treated to the extent that densities and/or rate of spread are reduced
Contain	Portions of the infestation are treated to prevent spread of the weed beyond the perimeter of the infestation

Other highlights of the proposal include:

- No aerial or large-scale broadcast spraying of herbicides will be permitted under this project.
- Application of chemical or biological treatments will meet or exceed standards and requirements prescribed by all applicable state and federal laws and regulations. This includes adherence to state permitting and licensing requirements for the application of herbicides.
- Most sites will require at least one follow-up treatment in future years, regardless of treatment method.
- Forestwide Standards and Guidelines (Appendix B) and Project Design Features (Chapter 2) will be applied.

Additionally, new infestations will be inventoried, monitored, and evaluated to determine if they can be controlled using this strategy developed. NNIP occurrences would be treated as they arise or are discovered on the Forest, without initiating a new analysis each time. This would allow the Forest Service to control new infestations more quickly and efficiently. Treatment methods that do not conform to the strategy established would require a separate analysis process. For example, prescribed burning to treat NNIP in designated wilderness areas is not analyzed as part of this project, so a separate analysis, including public involvement, would be initiated if new infestations requiring prescribed fire in these areas were proposed.

Numerous mitigation measures have been developed to minimize effects of the proposal. For a listing of the Design Criteria, and more details on the Proposed Action, please see Alternative 2 in Chapter 2 of this document and the Mark Twain National Forest website.

DECISION FRAMEWORK

The Forest Supervisor of the Mark Twain National Forest is the Responsible Official for selecting an alternative for the Mark Twain National Forest Non-native Invasive Plant Control Project. Based on this analysis, Forest Plan direction, and the results of public involvement, the Responsible Official must decide whether to proceed with a specific action.

The decision to be made is limited to which actions, if any, would be taken on the following items:

- What NNIP would be controlled,
- Where the NNIP control actions would occur,
- What type of NNIP control actions, methods, and tools to use, and
- What mitigation measures would be required to minimize impacts of our actions

A no-action alternative will be considered for this project decision. Under the no-action alternative, none of the proposed treatments of NNIP would occur at this time in the identified areas. Two action alternatives will also be considered in detail.

PUBLIC INVOLVEMENT

The Forest conducted an analysis of NNIP control and documented it in an Environmental Assessment finalized in early 2009. The NNIP control Decision Notice was administratively appealed and subsequently withdrawn in July 2009. A new NEPA analysis was initiated November 18, 2009, with distribution of scoping letters to 187 individuals, organizations, and agencies. Four comment letters were received in response to that solicitation. Those comments were incorporated into the analysis for the Draft EIS.

In this analysis, three additional chemicals and two biological agents have been added to the suite of proposed treatments. Also, the Missouri Department of Conservation has joined with the MTNF as a cooperating agency. Initial environmental analyses indicated that adding the chemicals and biological agents increased the scope and complexity of the project. Therefore, the Forest Supervisor determined that an environmental impact statement (EIS) was the most appropriate NEPA analysis for this project.

The Notice of Intent (NOI) for the EIS was published in the Federal Register on September 14, 2010. The NOI asked for public comment on the proposal by October 4, 2010. The Forest received two comments in response to the NOI.

Using the comments from the public, other agencies, and several Indian tribes, resource specialists on the Interdisciplinary team (IDT) developed a list of issues to address, as described in the Issues section of this document.

The Draft EIS was made available for the official 45-day public review and comment period in late June 2011. A Notice of Availability was published in the Federal Register on June 24, 2011 and a legal notice was published in the *Rolla Daily News* on June 30, 2011. We received nine (9) comment letters on the Draft EIS. These comments and our response to them are found in Appendix G. The letters themselves are available in the project file.

ISSUES

An issue is a point of debate, dispute, concern, or disagreement regarding anticipated effects of implementing the proposed action. The Responsible Official and the IDT identified internal and external issues and separated the issues into two groups: key and non-key issues. Key issues were defined as those directly or indirectly caused by implementing the proposed action. Non-key issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" If an issue does not show a problem with the proposed action, then it is considered not to be significant.

Key Issues: The Forest Service identified the following key issues during project design and IDT interaction:

Issue A: Treatment of non-native invasive plants could inadvertently impact non-target species. Herbicides could move offsite and affect non-target species and physical resources (i.e. water and soils). The type of herbicide, method of application, and the environment in which the herbicide is applied are all factors that influence whether or not herbicides move offsite.

> ***Measure:*** *Qualitative ratings of the overall potential for leaching, solution runoff, and adsorbed runoff based on chemical and physical properties of all proposed herbicides and soils.*

Issue B: The use of three bio-agents proposed for the control of spotted knapweed. They include a root weevil (*Cyphocleonus achates),* and two seed head weevils (*Larinus minutus, Larinus obtusus*.) The Missouri Departments of Conservation and Transportation have approval from the USDA - Animal and Plant Health Inspection Service (APHIS) and have been using these bio-agents on State lands adjacent to the MTNF since 2008. There has been no analysis of the effects on non-target plant species within the State of Missouri.

> ***Measure:*** *The number of potential release sites of root weevil and seed head weevils for spotted knapweed populations adjacent to native plants of concern, such as Centaurea Americana.*

Issue C: The Forest will not be able to eradicate or reduce certain NNIP populations without the use of herbicides.

> ***Measure:*** *The approximate number of acres that known mapped and inventoried NNIP populations would be eradicated or reduced with the use of herbicides.*

Non-Key Issues: The Forest Service identified the following issues during the project design and determined that they were not significant for the reasons stated below.

Use of 2, 4-D: During the beginning analysis phase, there was an internal concern identified concerning the impacts of 2, 4-Dichlorophenoxyacetic acid (2, 4-D) on surface and ground water resources, including specific downstream designated beneficial uses (drinking water supply, irrigation, livestock and wildlife watering, aquatic life for cold and warm water fishery, human health protection, whole body and secondary contact, and habitat for resident and migratory wildlife species.)

2, 4-D is the most commonly used herbicide worldwide and is one of the most studied of all registered herbicides. In the past, 2, 4-D was thought to be a carcinogen by some; however, the EPA has determined that the existing data do not support a conclusion that links human cancer to 2, 4-D exposure (EPA-HQ-OPP-2007-0434). 2, 4-D has been documented in surface water and groundwater sampling studies throughout the United States.

This issue is no longer a concern, due to additional analysis in this report on the occurrence of 2, 4-D in surface water and groundwater sampling in the State of Missouri. In both the USGS NAWQA study and Missouri Department of Natural Resources Drinking Water Assessments, 2, 4-D has been detected but never near the level of concern for drinking water and aquatic life.

Use of Aminopyralid: Early in the planning, there was an internal concern about the use of Aminopyralid (Milestone VM) and its persistence in the environment (up to 2 years). Originally, it was thought this herbicide's persistence in the environment, coupled with its high potential to reach surface water and groundwater, may affect non-target plants and designated beneficial uses for water resources, such as irrigation and aquatic life for cold-water fishery. During the analysis, the WIN-PST3 model from NRCS (see Soils section, page 54) was used to determine the Herbicide Active Ingredient Ratings, and for most proposed application scenarios, the ratings were low to very low. Mitigation measures such as SW1 further reduce these potential minimal impacts so that this issue is no longer significant.

OTHER RELATED EFFORTS

As mentioned in the purpose and need for the proposed action, the MTNF has authorized previous projects that address the control on NNIP species on the Forest. These efforts are small portions of larger vegetation management projects and did not or cannot keep pace with the extent in which several NNIP species spread and encroach into new areas. Species such as garlic mustard, spotted knapweed, and sericea lespedeza are too widespread and aggressive to be successfully addressed individually or at a smaller project level. In addition, smaller project level decisions have not allowed the Forest Service to implement an early detection and rapid response to newly discovered NNIP infestations, especially if ground disturbing activities or the use of herbicides not yet covered by NEPA analysis is required. The following table displays acres of NNIP treatment authorized in the past years that allow for limited NNIP treatments.

Table 1 Previous NNIP Control Efforts Authorized

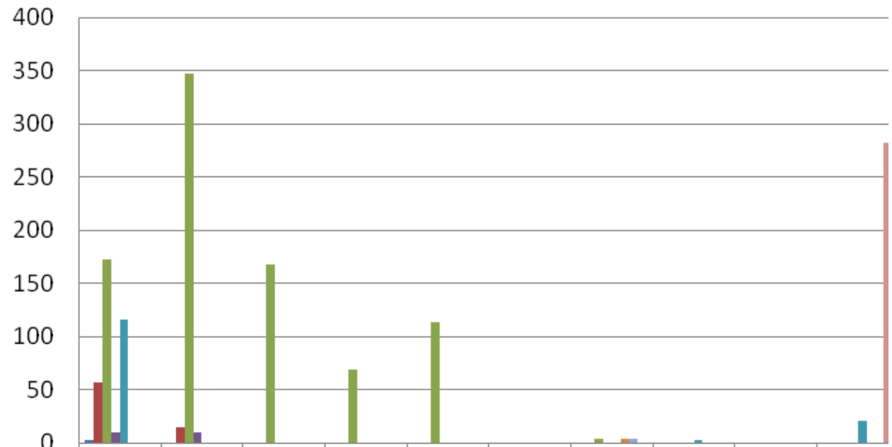
Project	Year Approved	NNIP Treatments Authorized
North Rock Creek	2005	90 acres of mechanical and chemical treatments
Crescent	2005	390 acres of fescue control utilizing mechanical/herbicide/burns
Garrison Ridge	2006	5 acres of hand pulling; 16 acres of herbicide spot treatments; and 190 acres of combined mowing and herbicide treatments
Shoal Creek	2007	56 acres on manual, mechanical and chemical treatments
Fairview	2007	21 acres of NNIP control (Sericea lespedeza) with glyphosate and triclopyr
Openland Grazing	2008	Control of NNIP infestations by mowing and grazing on 1,717 acres
Blue Hole	2009	NNIP treatments on 62 acres using an integrated approach utilizing manual, mechanical, and chemical treatments
Cane Ridge	2009	Chemical control of NNIP infestation using glyphosate on 34 acres
Southwest	2009	Non-native invasive weeds treatments through a combination of control methods including manual, mechanical, prescribed fire, and spot treatment with glyphosate, triclopyr, and fluroxypyr on approximately 1,688 acres.

Since 2000, control of NNIP has consisted primarily of a combination of manual (1,830 acres), mechanical (10,171 acres), and use of permitted livestock (cattle) grazing (1,682 acres). In addition, combinations of mowing with spot applications of herbicides have been completed on approximately 2,000 acres.

Manual treatment generally consisted of hand pulling and use of shovels to control such species as musk and bull thistles and stiltgrass. The majority of mechanical treatments on the MTNF consist of mowing, primarily fescue fields or hay pastures infested with NNIP such as Sericea lespedeza, multiflora rose, spotted knapweed, and thistles.

In total, approximately 394 acres of NNIP infestation have been treated with herbicides since 2000. This does not include all application of herbicides on the forest. Herbicides are used on rights-of-way by counties; Missouri Department of Transportation; utility company's use of herbicides along power lines; and use of herbicide by the Forest in campgrounds and administrative sites for poison ivy and other noxious weeds. Figure 2, shows the total amount of acres treated with herbicide on NFS lands in the last ten years. The spike in 2010 reflects the treatments authorized by the Southwest Project Decision Notice in 2009.

Figure 2 MTNF Herbicide Use (Acres Treated) since 2001



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
2,4-D (Amines)	2									
Fosamine Ammonium	57	15								
Glyphosate	173	347	168	69	113		3.5			
Hexazinone	10	10								
Triclopyr Amine	116							2		20
Imazapyr							3.5			
Metsulfuron-methyl							3.5			
Pasturegard (Triclopyr/Fluroxypyr)										282

CHAPTER 2 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

INTRODUCTION

This chapter describes and compares the alternatives considered for the Integrated Non-native and Invasive Plant Control Project. It includes a description of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between alternatives and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based on the design of the alternative (i.e., herbicide use vs. no herbicide use) and some of the information is based on the environmental, social, and economic effects of implementing each alternative (i.e., the amount of potential erosion caused by mechanical versus chemical treatment methods).

ALTERNATIVES CONSIDERED IN DETAIL

The Forest Service developed three alternatives, including the No Action and Proposed Action alternatives, in response to issues raised by the public.

ALTERNATIVE 1 – NO ACTION

Under this alternative, the Forest Service would not implement the activities listed in the proposed action or any other action alternative considered for this project at this time on the MTNF. There would still be some NNIP control on the MTNF based on past project decisions, and NNIP control would continue to be considered in future project decisions. Education and prevention efforts on the MTNF would continue. Inventory and mapping of NNIP infestations would also continue.

ALTERNATIVE 2 – THE PROPOSED ACTION

Each mapped and inventoried NNIP infestation on the MTNF is assigned a treatment objective to eradicate, reduce, or contain the infestation. The proposed action is designed to achieve these objectives through an integrated NNIP management program on the Forest. The proposed action would involve one or a combination of management approaches including manual, mechanical, biological, and chemical control methods. A document titled "Treatment Methods – Preferred Alternative" displays the site specific actions proposed, or "treatment methods," for each inventoried site, and is available on the Mark Twain National Forest website http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=30341. This 36-page document is summarized in Table 2 and hereby incorporated by reference.

Research and experience have indicated that integrated pest management is the most effective approach to managing NNIP species (Tu et al. 2001). Due to these various factors, one or several treatment methods may be needed in a given area annually for several years until treatment objectives are met. Manual treatments are effective in eradicating some NNIP species if only one to several plants is targeted. For example, one person with a shovel can dig up several scattered musk thistle plants within a relatively short period. Manual, mechanical, cultural and biological treatments are used to the extent that they are practical, but tend to be less effective if total eradication is the objective. Manual and mechanical treatments have limited effectiveness for eradication because they often fail to remove belowground reproductive propagules (rhizomes, stolen, culms, etc.). These types of treatment are costly and feasible only in small areas or in larger areas where containment or reduction of the infestation is the objective. The most effective and expedient way to eradicate an infestation is to use herbicides in combination with non-chemical methods. In many cases, only one treatment with herbicide is needed to eradicate an infestation. For example, two people may be needed to cut and grub out (uproot) a tree-of-heaven, but one person could inject or apply herbicide to the individual tree in a fraction of the time it would take two people to remove the tree.

The following 5 – Step process is followed determining and implementing NNIP treatments

6. **Identify and prioritize species/infestations**
    - **Priority 1** - Populations of aggressive NNIP species within prevention areas In addition, aggressive NNIP species outside of prevention areas likely to result in future management problem if not treated in a timely fashion.
    - **Priority 2** - NNIP populations adjacent to prevention zones or within specific pathways that facilitate spread of new populations of NNIP into prevention areas.
    - **Priority 3** - Populations of NNIP species that do not have an aggressive rate of spread and do not pose a significant management problem.
7. **Determine treatment objective**
    - **Eradicate** - Treat to the extent that no viable seed is produced over the entire infestation and all plants have been eliminate during current field season.
    - **Reduce** - The infestation is treated to the extent that densities and/or rate of spread are reduced.
    - **Contain** - Portions of the infestation are treated to prevent spread of the weed beyond the perimeter of the infestation.
8. **Determine the most economical and effective treatment**

    Refer to the document "Mark Twain National Forest Non-native Invasive Plant Treatment Methods" for the most up-to-date information for treating each type of NNIP. The choice of treatment methods takes into account the following factors:
    - Species and size of infestation
    - Relationship to the site to other infestations
    - Accessibility
    - Relationship of the site to federally listed species and species of concern
    - Distance to surface and ground water resources
    - Exposure to public
    - Effectiveness of treatment on target weed
    - Cost
9. **Implement according to MTNF Forest Plan Standard and Guidelines and Project design criteria**
    - Check Soil/Herbicide Interaction ratings for treatment site to determine if herbicides would be safe for use.
    - If herbicides are proposed for treatment, complete herbicide -use proposal (FS-2100-2) and have approved by District Ranger and Forest/Regional Herbicide Coordinator.

- If new or unmapped infestations require treatment objectives or methods not analyzed in this EIS, new NEPA analysis would be conducted.

10. Monitor for Effectiveness

- Evaluate treatment and determine if objectives are being met. If objective are not being met adjust treatment strategies.

The following table shows treatment objectives and recommended methods of treatment for the current inventoried NNIP infestations. The treatment objectives and methods are not static and subject to change based on factors mentioned above, e.g., once an infestation is reduced to a manageable size, a decision to eradicate the infestation can be made. Unmapped NNIP infestations would be treated similarly with regard to treatment objectives. If new or unmapped infestations require methods not analyzed in this EIS, new NEPA analysis would be conducted.

Table 2 Alternative 2 Treatment Objectives and Methods

NNIP Treatment Objectives and Methods	Approximate Acres
Eradicate	
Cultural/Mechanical/Chemical	17
Chemical/Biological	42
Manual	8
Manual/Chemical	214
Manual/Mechanical	3
Manual/Mechanical/Chemical	370
Mechanical/Biological/Chemical	479
Mechanical/Cultural/Chemical	218
Mechanical/Chemical	1,096
Eradicate Total	**2,446**
Reduce	
Cultural/Mechanical/Chemical	77
Manual/Cultural	92
Manual/Chemical	2
Manual/Mechanical	28
Manual/Mechanical/Chemical	432
Mechanical/Biological/Chemical	299
Mechanical/Cultural	18,653
Mechanical/Cultural/Biological	963
Mechanical/Cultural/Chemical	252
Mechanical/Chemical	154
Reduce Total	**20,953**
Contain	
Manual	4
Manual/Mechanical/Cultural	21

NNIP Treatment Objectives and Methods	Approximate Acres
Mechanical	701
Mechanical/Cultural	8,303
Manual	4
Contain Total	**9,028**
Grand Total	**32,428**

Treatment Methods

Treatment of NNIP sites will employ a wide-range of techniques. Appendix C provides a more in depth discussion of the implementation of these treatment methods. In addition, a document titled MTNF NNIP Treatment protocol is available at: Mark Twain National Forest – Projects.

Proposed manual treatments: (pulling, grubbing, hand-cutting, and digging with hand tools): Manual methods would be the principle method for controlling small infestations. Examples of hand tools that might be used include shovels, saws, axes, Pulaskis, loppers, hoes, or weed-wrenches.

Proposed mechanical treatments: Mechanical methods employ the use of a string trimmer, chain saw, brush saw, aquatic harvester, or mower, as well as tractors or other heavy mechanical equipment. These methods include mowing; tree/brush shearing, seeding, disking, and plowing. Plowing or disking might be used to restore heavily infested areas or to help establish desirable vegetation before infestation begins. Disking may also be used to construct a barrier around an infestation to prevent its further spread. Barriers such as black plastic or lake-bottom screens might also be used to prevent growth of non-woody NNIP species.

Proposed cultural treatments: Cultural control methods include the use grazing mammals, the Waipuna® hot foam system, scorching, smothering, and competition.

Proposed chemical treatments: The objectives of herbicide use are to control NNIP infestations where other methods would be cost-prohibitive, ineffective, or result in excessive soil disturbance or other resource damage. None of the herbicides proposed for use in this document are restricted use, and all would be used according to manufacturer's label direction for rates, concentrations, exposure times, and application methods.

In most cases, herbicides would be directly applied to the target NNIP using spot treatments, which consist of various techniques for applying herbicides to target plants without impacting desirable vegetation and other non-target organisms, including humans. Herbicide drift would be greatly reduced with spot treatment (relative to broad-scale application). Techniques that would be used include spraying foliage using hand-held wands or backpack sprayers, basal bark and stem treatments using spraying or wicking, painting (wiping) methods, cut surface treatments, woody stem injections, ATV,OHV (off-highway vehicle), or other vehicle-mounted boom sprayers, and skid sprayers. No herbicides would be applied aerially. Only herbicides labeled for use in or near aquatic systems would be applied in or adjacent to wetlands, lakes, and streams, in accordance with label direction. Obtain Regional Forester approval for all pesticide applications in Wilderness.

Specific herbicides that could be used where appropriate under the Proposed Action include the following:

2, 4-D ([2, 4-dichlorophenoxy] acetic acid) is a selective herbicide that controls invasive broadleaf herbaceous plants and woody seedlings, but does not harm certain monocots (including grasses). Aquatic formulations of 2, 4-D is effective for the control of Eurasian water milfoil and curly pondweed in lakes and ponds.

Trade names: Campaign®, Crossbow™;Weedmaster®

Application Methods: Stump and/or basal bark treatment, foliar spot spray; boom-sprayer

Application Rate: 1 lb a.e./acre

Examples of NNIP to be targeted: Tree of heaven, silk tree, thistles, wintercreeper, Eurasian water milfoil.

Human Health Risk/Ecological Assessment: SERA 2006

Aminopyralid (4-amino-3, 6-dichloro-pyridinecarboxylic acid) is a selective systemic herbicide that has been developed for the control of broadleaf weeds in rangelands and non-crop areas. It is especially effective in controlling biennial and perennial thistles and knapweeds. It has been reviewed by EPA and registered under the reduced risk herbicide initiative due to its low use rate and toxicity profile. Depending on specific treatment needs, aminopyralid can be used as a safer alternative to picloram, 2, 4-D, dicamba, and glyphosate.

Trade names: Milestone VM

Application Methods: Foliar spot and broadcast

Application Rates: 0.03 to 0.11 lb a.e./acre

Examples of NNIP to be targeted: Spotted knapweed, kudzu, musk thistle

Human Health Risk/Ecological Assessment: SERA 2007

Clopyralid (3, 6-dichloro-2-pyridinecarboxylic acid) is a selective herbicide that controls many annual and perennial broadleaf weeds. It is particularly effective against members of the legume, sunflower, nightshade, and knotweed families.

Trade names: Curtail™; Reclaim™ Transline™

Application Methods: Foliar spray

Application Rate: 0.1 to 0.5 lb a.e./acre

Examples of NNIP to be targeted: Kudzu, thistles, teasels, mimosa

Human Health Risk/Ecological Assessment: SERA 2004a

Dicamba (3, 6-Dichloro-o-anisic acid) is a selective herbicide that acts as a growth regulator effective against broadleaf species. It is typically applied in a mix with other herbicides.

Trade names: Banvel®, Brash®, Weedmaster®;

Application Methods: Stump and/or basal, bark treatment, foliar spot spray, boom-sprayer, broadleaf selective

Application Rate: 0.3 lb a.e./acre

Examples of NNIP to be targeted: Amur maple, privets, buckthorns, beefsteak plant

Human Health Risk/Ecological Assessment: SERA 2004b

Endothal (7-oxabicyclo [2.2.1] heptane-2, 3-dicarboxylic acid) is a selective, contact herbicide approved for use in lakes for the control of aquatic invasive plants.

Trade names: Accelerate®, Aquathol®, Hydrothol ®

Targeted Use: Submersed and floating aquatic weeds

Application Rate: 0.35-3.5 ppm a.e. for Aquathol formulations and 0.05-5 ppm a.e. for Hydrothol formulations.

Examples of NNIP to be targeted: Eurasian water-milfoil, curly pondweed

Human Health Risk/Ecological Assessment: SERA 2009

Fluroxypyr [(4-amino-3,5-dichloro-6-fluoropyridin-2-yl)oxy]acetic acid is a selective herbicide that controls invasive, broadleaf herbaceous and woody plants, but does not harm certain monocots (grasses). It is typically applied in a mix with other herbicides such as triclopyr.

Trade names: Pasturegard™

Application Methods: Stump and/or basal, bark treatment, foliar spot spray; boom-sprayer, broadleaf selective

Application Rate: 0.012 - 0.5 lb a.e./acre

Examples of NNIP to be targeted: Sericea lespedeza

Human Health Risk/Ecological Assessment: SERA 2009

Fosamine ammonium salt (FAS) (ethyl hydrogen [aminocarbonyl] phosphonate) is a selective herbicide that inhibits growth in undesirable woody species. FAS is usually applied to plants in the late summer and early fall; in most plants, effects of herbicide treatment are not evident until the following spring when buds fail to develop, or develop into miniature spindly leaves that do not provide adequate photosynthesis. This herbicide in often used as a "chemical trimmer" along road right of ways.

Trade names: Krenite®S, Krenite®UT

Application Methods: Foliar spray for woody brush control

Application Rate: 2 lb/acre

Examples of NNIP to be targeted: Olives, buckthorns, privets

Human Health Risk/Ecological Assessment: EPA Reregistration Eligibility Decision (RED)

Glyphosate (N-[phosphonomethyl] glycine) is a non-selective, broad spectrum, systemic herbicide used to control many grasses, forbs, vines, shrubs, and trees.

Trade names: Accord®, Roundup Pro®, Roundup® AquaMaster®

Application Methods: Stump treatment, foliar spray, non-selective

Application Rate: 0.5 lbs – 7 lbs a.e./acre.

Examples of NNIP to be targeted: Honeysuckle, Japanese barberry, garlic mustard and purple loosestrife, poison ivy, or any species near open water (aquatic formulation)

Human Health Risk/Ecological Assessment: SERA 2003a

Imazapyr 2-[4, 5-dihydro-4-methyl-4-(1-methylethyl)-5oxo-1Himidazol-2-yl]-3-pyridinecarboxylic acid – Imazapyr is a non-selective, low-volume, broad-spectrum herbicide that provides effective, long-lasting, post-emergent control of undesirable floating and emergent aquatic vegetation, grasses, broadleaf weeds, vines, and brush species; it is also used for site preparation and conifer release, and rights-of-way maintenance

Trade names: Habitat®

Application Methods: Low-volume foliar applications near water. Non-selective

Application Rate: 0.125 to 1.25 lbs a.e./acre

Examples of NNIP to be targeted: Purple loosestrife, Japanese knotweed, common reed (*Phragmitesaustralis),* or any species near open water.

Human Health Risk/Ecological Assessment: SERA 2004a

Sethoxydim (2-[1-{ethoxyimino}butyl] -5[-2-{ethylthio}propyl]-3-hydroxy-2-cyclohexen-1-one) is a selective herbicide used to control annual and perennial grasses. It has little or no impact on broadleaf herbs or woody plants.

Trade names: Poast®, Vantage®

Application Methods: Foliar spray; narrowleaf selective (graminoids)

Application Rate: 0.09375 lb/acre

Examples of NNIP to be targeted: Japanese stiltgrass, Johnson grass, cheatgrass, Caucasian bluestem

Human Health Risk/Ecological Assessment: SERA 2001

Triclopyr ([{3,5,6-trichloro-2-pyridinyl}oxy] acetic acid) is a selective herbicide that controls invasive, broadleaf herbaceous and woody plants, but does not harm certain monocots (grasses). It is particularly effective at controlling woody species with cut-stump or basal bark treatments.

Trade names: Crossbow™, Garlon™3A, Garlon™4, Pasturegard™, Vine-X®

Application Methods: Stump and/or basal bark treatment, foliar spot spray; broadleaf selective

Application Rate: 0.05 lb to 10 lbs a.e./acre.

Examples of NNIP to be targeted: Japanese barberry, Oriental bittersweet, autumn olive, honeysuckle, garlic mustard, sericea lespedeza, tree of heaven

Human Health Risk/Ecological Assessment: SERA 2003b

Proposed biological control treatments: Biological control of invasive plants involves releasing specific insects or other organisms that feed on or parasitize specific plant species. The insects are typically native to Europe, Asia, or other parts of the world where the target plant occurs naturally, and have been approved for release in the United States by the United States Department of Agriculture (USDA). Biological control of plants is already a common practice for some NNIP in Missouri. The biological control agents discussed in this document are listed below.

Biological Control	Scientific Name	Target Plant
root weevil	*Cyphocleonus achates*	Spotted knapweed

Biological Control	Scientific Name	Target Plant
seed head weevils	*Larinus minutus, Larinus obtusus*	Spotted knapweed
a rust fungus	*Puccinia carduorum*	musk thistle
black-dot leafy spurge flea beetle	*Aphthona nigriscutis*	leafy spurge
brown-legged leafy spurge flea beetle	*Aphthona lacertosa*	leafy spurge
copper leafy spurge flea beetle	*Aphthona flava*	leafy spurge
milfoil weevil	*Euhrychiopsis lecontei*	Eurasian water-milfoil

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

This alternative would allow control of NNIP populations by utilizing manual, mechanical, biological, or cultural treatment methods only. No use of herbicides would be authorized. The use of three biological agents proposed in Alternative 2, root weevil and seed head weevils would not be authorized. The remaining seven biological agents would be allowed. This alternative was developed in response to concerns related to unintended consequences from the use of herbicides and uncertainties about the release of root and seed head weevils. A document titled "Treatment Methods –Alternative 3" displays the site specific actions proposed, treatment methods and objectives, for each inventoried site, and is available on the Mark Twain National Forest website http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=30341. This 36-page document is summarized in Table 3 and hereby incorporated by reference.

Table 3 Alternative 3 Treatment Objectives and Methods

NNIP Treatment Objectives and Methods	Approximate Acres
Eradicate	
Manual	8
Manual/Mechanical	1
Eradicate Total	**9**
Reduce	
Manual	214
Manual/Cultural	92
Manual/Mechanical	650
Mechanical/Biological	3
Mechanical/Cultural/Biological	963
Reduce Total	**1,922**
Contain	
Cultural/Mechanical	94
Manual	6
Manual/Mechanical	729
Manual/Mechanical/Cultural	21

Mechanical	2,222
Mechanical/Cultural	27,425
Contain Total	**30,497**
Grand Total	**32,428**

PROJECT DESIGN CRITERIA

In addition to Forest Service policy, regulations, and Forest Plan standards and guidelines (S&Gs), specific design criteria (best management practices (BMPs)) have been developed for NNIP treatment on the Mark Twain National Forest. During the analysis of this project, resource specialists identified specific design criteria, beyond the Forest Plan S&Gs, which would further reduce the potential for adverse effects to particular resources. All design criteria are applicable to Alternative 2. Design criteria specific to herbicide application are not necessary for Alternative 3.

Use of herbicides in Alternative 2 will adhere to Forest Service Manual (FSM) 2150, Herbicide-Use Management and Coordination and Forest Service Handbook (FSH) 2109.14, Herbicide-Use Management and Coordination Handbook. As required by FSH 2109.14, sec. 74, a Herbicide-Use Proposal (FS-2100-2) must be completed before the application of herbicides, except for housekeeping-type herbicides (such as Roundup used to kill poison ivy around work centers, recreation areas, etc.), and herbicides used in amounts less than 1 pound of active ingredient for any one project. District Rangers shall coordinate the preparation of Form FS-2100-2, Herbicide-Use Proposal for all proposed use of herbicides within the District, including uses by licensees, permit holders, grantees, States, and other Federal agencies. District Rangers shall approve or disapprove those proposals for which they have been delegated authority. If there is any question about the type, amount, and application procedure of the herbicides being proposed, a request for technical approval from the R9 Herbicide Use Coordinator will be required.

In order to protect the public and employees from unsafe work conditions when herbicides are involved, Forest Service Manual 2153.3 requires a safety plan for all herbicide-use projects, except housekeeping-type uses and minor uses of less than one pound active ingredient for any one project.

The first three design criteria (A1, MA1, and MC1) are prevention measures created to minimize unintended spread of NNIP. The remaining design criteria were created to mitigate unintended impacts to non-target species (Issue A & Issue B).

Administrative (A)

A1 - All equipment, boots, and clothing must be inspected and cleaned of all vegetation debris and soil before moving from the treatment site to ensure that propagules are not transported to other sites. Inspection of the rigs should be done on-site by the project leader or contract administrator.

Manual Controls (MA)

MA1 - NNIP parts capable of starting new plants (seeds, rhizomes, etc.) will be disposed of properly. Plants may be piled and burned on site or bagged and moved off site. Bagged plants will either be incinerated or receive standard garbage disposal. For large woody bushes that would be difficult to move, treatments should be scheduled prior to seed set.

Mechanical Controls (MC)

MC1 - Use of mowing as a NNIP control should be timed to avoid spreading seeds (i.e., before seed set).

Cultural Controls (CC)

CC1 - The weed torch will be used only during times of low fire danger, on sites with low potential to carry a fire, and with a wildland firefighter on site.

General Herbicide Application (GH)

GH1 - When herbicide must be applied during the growing season, a selective herbicide should be used to reduce effects to non-target vegetation. If a selective herbicide is not available, a selective method of herbicide application will be used to minimize affects to non-target species.

GH3 - Herbicides will be sprayed with a boom only when wind conditions are less than 10 miles per hour, or lower wind speed if so directed by the manufacturer's label.

GH4 - Prevailing weather conditions will be considered and lower volatility formulations used under conditions that might result in a high risk of volatilization.

GH5 - Weather forecasts will be obtained prior to herbicide treatment. Treatment activities will be halted, if necessary, to prevent runoff during heavy rain or drift during high wind events.

GH6 - The lowest spray boom and release height possible, consistent with operator safety, will be used.

Threatened, Endangered, Sensitive Species (TES)

TES1 - Areas to receive herbicide treatment will be visited as needed to ensure protection of threatened, endangered, and sensitive (TES) species. If any TES species are located, then appropriate protective measures will be implemented according to Forest Plan Standards and Guidelines, Programmatic Biological Opinion Terms and Conditions, and/or Design Criteria.

TES2 - Hand application of herbicides to stumps or cut surfaces (cut and stump treatment) or basal bark (basal bark treatment) on woody plants will be utilized wherever possible in areas known to contain rare or sensitive wildlife.

Ozark hellbender, scaleshell mussel, pink mucket, spectaclecase

TES3 - To avoid impacts from trampling, manual methods must be avoided in areas of documented Ozark hellbender, pink mucket, scaleshell mussel, and spectacle case occurrences. Areas of documented occurrences include a 100 m area around known hellbender sites and the length and width of the known T&ES mussel beds. If mussel beds are discovered while implementing manual methods in undocumented areas, manual methods must cease until the area is surveyed for those species.

Hine's emerald dragonfly and Tumbling Creek cavesnail

TES4 - No herbicides will be used within any fen (the fen proper) known to be occupied by Hine's emerald dragonfly larvae or adults or within hydrologically connected drainage features unless a "wicking method" is approved by USFWS and FS hydrologist.

TES5 - Unless approved by the USFWS and the FS hydrologist, no endothall or triclopyr will be used within fens known to contain Hine's emerald dragonfly larvae or adults or the fen buffer area. The fen buffer area is defined as 0.5 miles upstream of the fen and 300 feet on the lateral sides of perennial streams that may feed into that fen within 0.5 miles upstream.

TES6 - When implementing manual vegetation control methods in fens known to contain larval or adult Hine's emerald dragonflies, the number of personnel working in the area will be limited, and will be made aware of the need to avoid trampling crayfish burrows to the maximum extent possible. A Wildlife Biologist must be present during manual activities.

TES7 - No biological control will occur in fens known to contain Hine's emerald dragonfly larvae or adults.

TES8 - No application of herbicides will occur in the Tumbling Creek cavesnail recharge area within 72 hours prior to expected precipitation.

TES9 - If new NNIP infestations are documented within the Tumbling Creek cavesnail recharge area, consultation with the U.S. Fish and Wildlife Service will be reinitiated prior to treatment decisions. This consultation may be informal in nature.

Running buffalo clover, Mead's milkweed, and Virginia Sneezeweed

TES10 - When necessary to apply herbicides within 25 feet of threatened and endangered (TE) plants, herbicide must be applied under the direct supervision of an individual who knows how to identify TE plant species.

TES11 - All herbicide use within 25 feet of TE plants must be applied by hand using spot application treatments and during conditions when winds will not cause spray to drift toward TE plants.

TES12 - TE plant sites will not be mowed, plowed, or disked, grazed, or otherwise disrupted until seed has set.

Soil and Water (SW)

SW1 - The use of highly mobile herbicides (Dicamba and Clopyralid) shall be avoided on soils with highly leachable properties where the Soil–Herbicide Interaction, Leaching, Solution Runoff and Adsorbed Runoff Potential are rated high or extra high. For soils with an intermediate rating, a field visit by a soils specialist must be made prior to application.

SW2 - In areas with soil disturbance or pre-emergent herbicide use, erosion controls will be implemented to prevent soil loss or habitat degradation as needed.

SW3 – Aquatic herbicides will only be applied to man-made impounded waters, i.e. lakes and ponds.

Cultural Resources (CR)

CR1 - If cultural resources indicator species are targeted for treatment, the activity will be considered an undertaking under Section 106 of the National Historic Preservation Act.

- A records review will be conducted to determine whether or not the treatment area has been previously adequately inventoried for cultural resources.
- If the area has been previously inventoried and historic properties [as defined in 36 CFR Part 800.16(l)(1)] are located within the project area, heritage staff will determine: 1) whether a population of the targeted cultural resources indicator species is present within the site boundary; and 2) whether the population is a contributing feature to the site.

- If yes, appropriate mitigation measures will be implemented.
- If the area has not been previously inventoried, heritage staff will conduct a reconnaissance level inventory designed to locate cultural resources indicator species and determine the presence/absence of associated cultural resources.
- Based on the results of the inventories and the determination of effect, appropriate mitigation measures will be implemented.

CR2 - If there is a potential for cultural resources indicator species to be eradicated inadvertently during the course of treating other targeted species (for example herbicide application using techniques other than those designed for spot treatment), the activity will be considered an undertaking under Section 106 of the National Historic Preservation Act.

- A records review will be conducted to determine whether or not the treatment area has been previously adequately inventoried for cultural resources.
- If the area has been previously inventoried and historic properties [as defined in 36 CFR Part 800.16(l)(1)] are located within the project area, heritage staff will determine whether a plant population is present within the site boundary that is a contributing feature to the site.
- If yes, appropriate mitigation measures will be implemented.
- If the area has not been previously inventoried, heritage staff will conduct a reconnaissance level inventory designed to locate cultural resources indicator species and determine the presence/absence of associated cultural resources.
- Based on the results of the inventories and the determination of effect, appropriate mitigation measures will be implemented.

ALTERNATIVES CONSIDERED BUT ELIMINATED

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives were outside the scope of controlling NNIP populations on the MTNF, duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Therefore, a number of alternatives were considered but dismissed from detailed consideration for reasons summarized below.

An alternative that would not allow the use for 2,4-D was considered but dropped from further analysis. For many years 2,4-D was thought to be linked to human cancer. The IDT decided not to include this alternative base on the following:

> A study by Garabrant and Philbert (2002) concluded no experimental evidence exists supporting the theory that 2,4-D or any of its salts and esters damages DNA under physiologic conditions. The Environmental Protection Agency (EPA) reached similar conclusions, and following its re-registration of 2,4-D in 2007 stated, “Because the Agency has determined that the existing data do not support a conclusion that links human cancer to 2,4-D exposure, it has decided not to initiate a Special Review of 2,4-D, 2,4-DB and 2,4-DP” (Federal Register,

August 8, 2007). The EPA's conclusion is supported by a suite of studies that reach similar conclusions (http://envirocancer.cornell.edu/Bibliography/herbicide/bib.2_4-d.cfm).

2,4-D is one of the most commonly used agricultural and home and garden products in the United States, and, along with triclopyr and dicamba, is one of the most commonly used herbicides to selectively control weeds in Missouri. 2,4-D products are also registered for aquatic weed control, and this is another important reason for maintaining it as a viable option for control of noxious weeds along rights-of-way (that have numerous stream crossings), or when NNIP occur near wetlands, including streams, lakes, and in riparian areas.

Project design criteria would further eliminate or reduce any potential for adverse effects following the use of this chemical. Therefore, we decided to leave 2,4-D in our toolbox.

An alternative that included the use of Fluridone for the treatment of aquatic weeds in lakes, such as curly pondweed and Eurasian milfoil in Loggers Lake and Council Bluff Lake was considered but dropped from consideration due the following reason.

According to the EPA, the most recent ecological risk assessment was completed in 1991 (US EPA 2010). The 1991 review included reference to a biological opinion written by the U.S. Fish and Wildlife Service which found, "the registration of this product as proposed is likely to jeopardize the continued existence of all listed U.S. freshwater aquatic species including plants, fishes, reptile, amphibians, and invertebrates (principally mussels) and is likely to destroy or adversely modify all aquatic designated critical habitat" (US EPA 2010). The US FWS review predicted direct and indirect risk to reproduction of aquatic organisms and risk to aquatic vegetation, requested additional studies, and concluded that a risk assessment on revisions for increased application rates could not be completed until data were submitted. Currently the EPA is reviewing the re-registration of fluridone, and studies have not been fully completed.

Most of the submitted studies for effects to aquatic organisms were completed in the late 1970s and early 1980s, and studies concluded fluridone is "moderately toxic to aquatic organisms". These studies are currently under review to determine if the studies still meet guideline requirements (US EPA 2010). The EPA states "special attention will be given to whether an accurate estimate of exposure can be established. In many of the studies, precipitate was present and treatment levels exceeded the level of solubility. The concentration was measured in most of the studies; however, in some studies the water was not centrifuged or filtered to remove any herbicide that would be bound to organic matter or present as a precipitate. Therefore, the measured concentration likely exceeded the exposure concentration" (US EPA 2010).

We concluded that the use of Floridone was not worth the risk of unacceptable environmental effects. We have other effective, low-risk treatment options, such as Endothall, that would meet our objectives. Therefore, we decided not to include Floridone in any alternative considered in detail.

An alternative that included the use of prescribing burning to control NNIP was considered but dropped from detailed analysis.

Use of prescribed fire to control NNIP species was one tool included in the original proposed action. Prescribed fire can be an effective tool for some NNIP species to contain and in some cases reduce infestations. It is also effective in combination with other treatment methods such and mechanical and herbicide application. Early in the environmental analysis stage, It was determined that prescribed burning as a tool, used solely for NNIP treatments is rarely used on the MTNF. Prescribed burning is a complicated process, involving highly qualified personnel, contingency plans, and appropriate weather conditions. Prescribed fire activities on the MTNF are generally conducted on relatively large acreages (>100 acres) compared to NNIP infestation (< 20 acres). Prescribed fire priorities are to apply fire at a large enough scale to affect desired changes in natural communities and fuels reduction. It would be atypical to spend the time, money, and effort necessary to conduct a prescribed burn solely to treat NNIP. Therefore, prescribed fire was dropped from the proposed action.

This does not forego the opportunity complete site specific NEPA to utilize prescribed fire in the future for NNIP management. Currently, NNIP treatments are considered a secondary benefit to existing ecosystem and fuel reduction prescribed burn if the certain fire intolerant NNIP (i.e. kudzu, bush honeysuckle) are present.

An alternative that included the use of included the use of flower head weevil (*Rhinocyllus conicus)* and rosette weevil (*Trichosirocalus horrid)s* to reduce the impacts of non-native thistles was considered was considered but dropped from detailed analysis.

Use of both of these weevils was considered in the original proposed action. The first success in biological control of musk thistle was documented in 1975 soon after the weevils were released in Virginia. Typical musk thistle stand reductions of 80-95% occurred in sites where the weevil became established. Entomologists with the USDA Agricultural Research Service Biological Control of Insects Research Laboratory in Columbia, Missouri, released flower head weevils in 1975 near Marshfield in Webster County. In areas of the state where the weevils have been present for the longest period of time, a 70–90 percent reduction in thistle population has occurred. Although populations of musk thistle weevils have increased throughout the state through natural dispersion and through collection and re-colonization, they only provide partial control of musk thistle because the egg-laying period of the weevil coincides with the development of the terminal thistle heads, but not the lateral heads. Both weevils are considered established in the Missouri counties were they have been introduced.

The plant species tested in the screening trials in the 1960s included primarily agricultural crops and horticultural species in the Asteraceae family, plus a few European thistles. Since the cultivated plants tested were not used by the weevil, and the potential use of native North American *Cirsium* species was not a concern at that time, R. conicus was approved and released in the United States (in 1969). *Rhinocyllus conicus* has been reported in flowerheads of nearly 20 native *Cirsium spp*. in the west and in the central plains and mountains (Louda, 2000).

USDA APHIS no longer permits these weevils for environmental release since both have been documented as nonspecific feeders of thistles. Therefore, the use of these biological agents has been dropped from the proposed action.

Scoping commenter suggested that we "Prepare Significant Plan Amendment/SEIS to include standards for treating NNIS."

This alternative was considered but eliminated from detailed consideration in the analysis for the following reasons. The Forest Plan already includes forestwide standards and guidelines for NNIS management on page 2-2. It includes S&Gs for pesticide use (including herbicide) on page 2-20. These S&Gs, along with all others pertinent to the proposed actions, are incorporated into the INNIP EIS (see Appendix B). This INNIP EIS considers specific actions on specific conditions throughout the Mark Twain National Forest. Through the analysis, we developed mitigations (project design criteria) to minimize the potential adverse impacts from these specific actions. We considered whether a Forest Plan amendment was necessary, and determined that it was not because the project is consistent with the plan. We did not prepare a Forest Plan amendment or supplemental EIS because it would be redundant and unnecessary.

Scoping commenter requested we consider an alternative that promulgates Categorical Exclusion authority to treat NNIS.

In response to our scoping solicitation, Jim Bensman of Missouri Forest Alliance wrote, "The Forest Service [should] promulgate CEs to deal with NNIS. As a bare minimum, this is a reasonable alternative that needs to be developed. We recognize the Forest Supervisor discussed this with your Washington Office and this was rejected. However, the CEQ Regulations state, 'Agencies shall continue to review their policies and procedures and in consultation with the Council to revise them as necessary to ensure full compliance with the purposes and provisions of the Act.' 40 CFR § 1507.3. We believe the Forest Service's failure to propose NNIS CEs violates this requirement. If dealing with NNIS is truly a priority for the Forest Service, then developing CEs would also be a priority." This alternative was not carried forward in detail because it is outside the authority of the Forest Supervisor and not within the scope of the decision to be made for this project-specific EIS. Establishing a category for exclusion from documentation in an EA or EIS for our use is reserved for the Secretary of Agriculture (7 CFR part 1b.3) or the Chief of the Forest Service (36 CFR 220.6(a)).

COMPARISON OF ALTERNATIVES

This section provides a summary of the effects of implementing each alternative. Information in the table is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 4. Comparison of Alternatives

Objective or Issue	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3 (No Herbicides, limited biocontrol)
Objective: Protect and restore native ecosystems	NNIP will continue to spread, with adverse impacts on natural communities, TES, etc.	Beneficial effect; 72% of NNIP would be targeted for eradication or reduction. Move toward restoring natural communities.	Beneficial effect; 6% of NNIP would be targeted for eradication or reduction. Most (94%) NNIP treatment objectives in "control" Less movement toward restoring natural communities
Objective: Reduce or eliminate NNIP sites	No NNIP sites would be reduced or eliminated through this decision	Eradicate 8%; Reduce 64%	Eradicate < 0.03%; Reduce 6%
Issue A: Herbicides could move offsite and affect non-target species and physical resources	No effects	Limited, localized, short-term effects; no cumulative effects	No effects
Issue B: Biological controls could have unintended effects to non-target plant species and the biological environment – Measure #of potential release sites near Centaurea Americana	No effects	Of the 34 potential release sites, there are no known populations of *Centaurea Americana*	No adverse effects
Issue C: Ability to eradicate certain NNIP populations without the use of herbicides	Not applicable	Eradicate 2,447 ac Reduce 20,953 ac	Eradicate 9 ac Reduce 1,922 ac
Forest Plan Consistency	Not applicable	All actions are consistent with the Forest Plan	All actions are consistent with the Forest Plan

PREVENTION AND EDUCATION

Prevention and education are not a part of this NNIP control project because these activities are incorporated into the day-to-day activities of the MTNF. Furthermore, prevention of NNIP spread is recognized as a primary mission of the USFS (USDA Forest Service, 2003). The USFS is implementing prevention measures to varying degrees on National Forests and Grasslands across the United States, including the MTNF. Among the most widely adopted practices are

NNIP risk analysis in project-specific environmental analyses, washing equipment before entry to USFS lands, and re-vegetation of treated NNIP sites. Education efforts on the MTNF include presentations to employees and the public, posting information at recreation areas, boat launches, and trailheads, web-site postings, displays at offices and events, and individual contacts.

Weed prevention zones have been identified on the MTNF. These areas, encompassing approximately 825,000 acres, are comprised of springs, seeps, fens, riparian management zones, wilderness, and Management Areas (MA) 1.1, 1.2 and 8.1, and other areas of high quality biological diversity. These areas are priority for preventing new populations of NNIP population from becoming established.

CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This Chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter.

The following are definitions of terms used in discussing the environmental effects of proposed activities.

Affected environment (40 CFR 1502.15) is a brief description of the area(s) to be affected by the proposed activities. The description shall be no longer than is necessary to understand the effects of the alternatives. **Direct effects** (40 CFR 1508.8) are those occurring at the same time and place as the triggering action (e.g. Herbicide effects on target and non-target plant species). **Indirect effects** (40 CFR 1508.8) are those caused by the action, but occur later, or at a distance from the triggering action, (e.g. Sediment input into streams due to a loss of vegetative cover from treatment of noxious weeds populations). **Cumulative effects** (40 CFR 1508.7) are the effects on the environment that results from incremental effect of the action added to the effects of other past, present, and reasonably foreseeable future actions, regardless of whether or not the agency or person undertakes them and regardless of land ownership on which other actions occur. An individual action when considered alone may not have a significant effect, but when its effects are considered in addition to effects of other past, present, and reasonably foreseeable future actions, the effects may be significant (e.g. The effects of herbicide use on water quality).

The cumulative effects analysis for each alternative is evaluated separately for each resource and may have different spatial and temporal boundaries. Agencies are not required to list or analyze the effects of individual past actions unless such information is necessary to describe the cumulative effect of all past actions combined. The analysis of cumulative effects begins with consideration of the direct and indirect effects on the environment that are expected or likely to result from the alternative proposals for agency action. Agencies then look for present effects of past actions that are, in the judgment of the agency, relevant and useful because they have a significant cause and effect relationship with the direct and indirect effects of the proposal for agency action and its alternatives.

The USDA Forest Service uses the best available science and most reliable and timely data available. Accuracy from the Geographical Information Systems (GIS), Natural Resource Information System (NRIS), Forest Service Activity Tracking System (FACTS), Rangeland Infrastructures Database (INFRA) and other databases vary in accuracy. All attempts to verify and update this information have been made where possible. The IDT is keenly aware of the need to ensure the scientific integrity of the information used in this analysis.

The affected areas are all lands on the National Forest susceptible to infestation by NNIP. Except for the Cedar Creek Unit, which lies just north of the Missouri River in Boone and Callaway Counties, the majority of the affected area lies in the southern half of Missouri, including portions of Barry, Bollinger, Butler, Carter, Christian, Crawford, Dent, Douglas, Howell, Iron, Laclede, Madison, Oregon, Ozark, Phelps, Pulaski, Reynolds, Ripley, Shannon, Ste. Genevieve, St. Francois, Stone, Taney, Texas, Washington, Wayne, and Wright Counties, Missouri. The administrative boundaries of the MTNF encompass 3,108,818 acres and include tracts of National Forest System land totaling 1,497,847 acres.

VEGETATION

AFFECTED ENVIRONMENT

The Forest Service National Hierarchical Framework for ecological classification consists of domains, divisions, provinces, and sections. The MTNF is primarily located in the Central Interior Broadleaf Forest province of the Hot Centennial division of the Humid Temperate domain (McNabb et al 2005). Provinces are further broken down into section and subsection. Over 95% of the Forest falls within the Ozark Highlands Section, a distinctive biogeography region that includes most of southern Missouri. The Ozark region is characterized by flat to gently rolling plains that formerly supported prairies, savannas, and open woodlands. The plains give way to rugged, highly dissected hills breaks flanking major streams that dominate region. These areas are dominated by oak and pine-oak woodlands and forest. The subsections are further delineated into landtype associations and are described in detail In the *Atlas of Missouri Ecoregions* (Nigh and Schroeder 2002).

The MTNF contains a diversity of forest cover types that can be broadly grouped into 7 Forest Cover types (Figure 3), and the remaining parts of the Mark Twain National Forest consist of smaller natural communities such as glades, calcareous fens, and acid seeps, as well as pastures lands, riparian areas, streams, and sinkholes. There are over 2,000 plant species known to inhabit the MTNF. A more detailed discussion of the vegetation resource of the Mark Twain lands is found in the Mark Twain National Forest Land and Resource Management Plan (2005a), on pages 3-41 to 3-65.

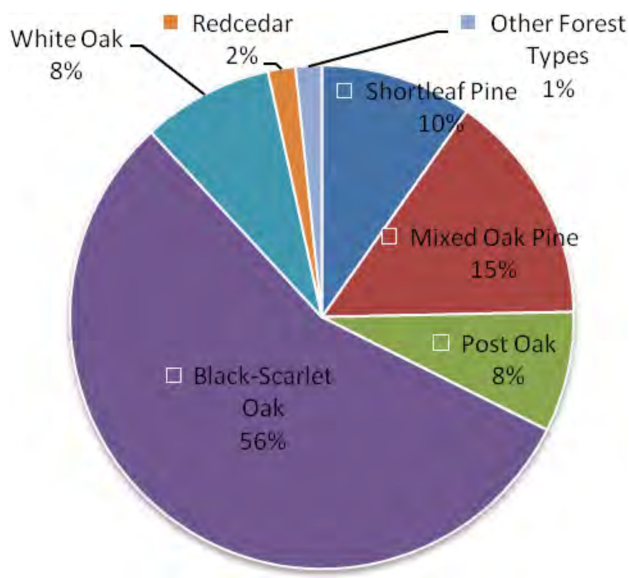


Figure 3 MTNF Forest Cover Types (Source FSVeg database)

Non-native Invasive Plants: Nationally, NNIP are estimated to infest 100 million acres in the U.S., and they invade an additional three million acres annually. The presence of NNIP continues to increase in Missouri, as is the pattern throughout the rest of United States. Thirty-seven plant species identified by either the State of Missouri or Region 9 of the Forest Service as currently or potentially invasive occur on the MTNF (Appendix A).

On the Mark Twain National Forest, NNIP are common along roadsides, skid trails, recreational trails, campgrounds, old fields, and other highly disturbed sites where vegetation and soil disturbance have provided opportunities for the invasion of NNIP into these disturbed areas. Some NNIP are also present in streams, lakes and ponds, as well as in forests and woodlands. These plants often completely dominate their niche (e.g., understory shrub layer or herbaceous layer) crowding out native plants, hindering native tree regeneration, and altering wildlife habitat.

Invasive plant "pathways" are the means by which they are moved from one location to another. Natural pathways could include means such as wildlife, wind, or water currents. Other pathways can be enhanced by, or even entirely created through, human activity. Sometimes this is done intentionally, other times quite unintentionally.

The seeds of invasive plant may attach to a deer or fur of a rabbit and spread naturally within their native range or be carried down river during flood events. Seeds can also attach to the pants or boots of a hiker who then carries it to new locations, sometime, miles away. Seeds contribute to the spread of NNIP when they attach to vehicles and OHVs and. Each of these represent different pathways, natural or human-mediated, enhanced or wholly artificial, intentional or unintentional, that affect how rapidly and to what places a species is moved. If the species thrives in its new home, the whole cycle of opportunities for spread is begun again from this new location. Pathways are thus simply the "modes of transportation" for how species move about.

There are approximately 4,512 Forest Service system and non-system roads and 673 miles of designated motorized and non-motorized trials within the MTNF. There are over 7,000 miles of County roads that are located within the MTNF proclamation boundary. Based on the current NNIP inventory, there are approximately 987 miles roads and 377 miles of designated trials that are infested to some degree with NNIPs. The actual miles infested are probably much higher. In fact, an invasive plant population is likely to be encountered on any of the primary travel routes on the MTNF.

On the MTNF the NNIP that are spread by human activity on roads and trails tends to be Johnson grass, Sericea lespedeza, spotted knapweed, cheat grass. Species such as multiflora rose, Japanese honeysuckle, and tree of heaven are more often spread by wildlife (i.e. birds). Several species such as garlic mustard, purple loosestrife, Japanese stiltgrass, and multiflora rose are more commonly spread by floodwaters along stream courses.

NNIP inventories and manual control methods have been ongoing since 1997. There are currently 1,966 NNIP infestations on the MTNF, on 32,430 acres.

DIRECT AND INDIRECT EFFECTS ON VEGETATION

ALTERNATIVE 1 – NO ACTION

As stated in the purpose and need, the resiliency and integrity of natural communities on the Mark Twain National Forest will be increasingly affected if NNIP infestations are allowed to continue to spread and to invade previously unaffected areas. Under this Alternative, the Mark Twain National Forest would continue to be a potential source of infestations for surrounding lands.

Under Alternative 1, no additional NNIP control activities would occur beyond those NNIP treatments that are part of existing project decisions or current project analyses. NNIP prevention practices, such as equipment cleaning, would continue to be a requirement in all applicable projects, and would help decrease the human-caused spread of NNIP from these sites. As it will under all alternatives, NNIP education will continue, and this may have some affect on reducing future infestations. In other words, control of NNIP would continue as in recent years with minor efforts in areas currently being treated annually and in those projects where NNIP control was included in the project analysis. Invasive plants within 5.1, 6.1, 6.3, and 8.1 Management Prescription Areas would, for the most part, remain untreated.

Taking no action to control NNIP infestations would have no direct effects to native plant species and natural communities. However, failure to control NNIP could indirectly affect natural communities through competition with native plant species for space and resources (Stinson, et al. 2006). No action would allow invasive plants to persist and spread, which could cause a decline in the quality of lands forestwide, especially rangelands and natural communities, and their ecological function (Horsley and Marquis 1983, Swearingen 2004, National Invasive Species Council 2001). Failure to control NNIP will likely result in continued infestation throughout the MTNF (as well as adjacent nonfederal lands) and a decrease in diversity and abundance of native species and natural communities.

Continued efforts to control NNIP would occur as part of other MTNF projects, but sites that are not actively managed would not benefit from these efforts. However, sites that are adjacent to projects with NNIP control may also benefit from those actions, although they would not allow the Forest Service to target: 1) NNIP populations with the most potential to harm quality habitat, or 2) those infestations with the most potential to spread to other portions of the MTNF. The large amount of seeds produced by some NNIP[1] makes it likely that they will spread from untreated areas to new areas of the MTNF. Overall, without organized and prioritized treatment actions, NNIP sites will expand in non-project areas and spread to other parts of the MTNF and neighboring lands, including more interior and less disturbed sites.

ALTERNATIVE 2 – PROPOSED ACTION

Direct and Indirect Effects: Identified NNIP sites are most likely to be contained (prevented from spreading) under this alternative, and the treatment actions in the proposed action are expected to result in a reduction of NNIP across the MTNF.

This alternative employs manual, mechanical, chemical, cultural, and biological control methods to eradicate, contain or control NNIP. All control actions will follow the project design criteria, which will greatly minimize short term adverse effects on native plants. Some Project design criteria are specific to a particular practice.

Manual/mechanical control: Most of the proposed manual treatments are highly selective, with very little potential to harm adjacent non-target plants. These include hand-cutting, hand-pulling, and digging. These practices would occur in areas where non-target plants are present. In addition, operators who are trained to distinguish between NNIP and native species will be used to reduce the likelihood of negative impacts to non-target plants. This is particularly true in areas where rare species are known. This combination of highly selective techniques and trained operators should greatly reduce direct impacts to non-target plants.

Mechanical actions are less selective. For example, mowing may reduce the vigor and reproductive ability of native plant species, in addition to the targeted NNIP. Mowing will also affect all vegetation in a treatment area, and so is best suited for highly infested sites that cover large areas.

In this alternative, mowing is limited to those highly disturbed areas (Project design criteria) such as roadsides and range allotments because it disturbs most of the vegetation in the treated area. Mowing can provide temporary control of some perennial weeds and most annuals. Defoliation interferes with production of stored carbohydrates and eventually depletes reserves and weakens the plant, reducing competitive ability and seed production. Mowing sericea lespedeza after mid-July can delay or reduce seed production. It will also reduce the growth rate of the sericea lespedeza the following year.

Some NNIP such as spotted knapweed, can propagate and seed at minimal heights that may be as low as one inch. Other species, such as Canadian thistle, will expand

[1] Spotted knapweed, musk thistle, cheat grass, and garlic mustard are some NNIP that annually produce large amounts of seed. For example, a single spotted knapweed plant can produce an average of 1,000 seeds per plant, and seedling density of garlic mustard in infested areas can reach nearly 17,000 per square yard in the fall, although overwintering mortality is high and rosette density in the spring averages 25 to 70 per square yard, but occasionally reaches as high as 375 per square yard.

their root system in response to mowing. In these cases a single mowing is not always effective and repeated mowing may be necessary.

Timing of mowing is critical; mowing after seed set usually spreads NNIP. Although mowing can be timed in such a way that it favors native or desired plants, and discourages NNIP, mowing would have a negative impact on some non-target plants.

Limiting this practice to roadsides, range allotments, and similar sites, and by targeting the treatment to the infested areas, will reduce this impact. In addition, many of these sites are already mowed as part of routine maintenance programs to maintain open fields.

Scorching (with a propane weed torch) is another method that has the potential to impact non-target plants. For this reason, this activity will be conducted only very early or very late in the growing season when non-target plants are dormant (project design criteria).

Overall, the negative effects of manual/mechanical control on non-target plants will be minimized by Project design criteria. The native plant communities benefit from NNIP treatments by reducing competition that protects species richness and diversity and soil fertility.

Chemical control: All herbicides proposed in this alternative are capable of killing or injuring non-target plants. Five factors greatly influence the degree to which this may occur: 1) application method, 2) application conditions, 3) season of application, 4) choice of herbicide (based on selectivity), and 5) operator training.

1. Application Method. Most herbicides will be applied by hand through one of several methods. However, where hand-application is neither feasible nor practical, a boom-sprayer or skid-sprayer with retractable hose and wand may be employed. Most hand-application methods are very direct, since the operator is able to selectively and directly apply herbicide to the target plants. Hand-application methods include:

A. herbicide injection into woody trees and shrubs,
B. cut-stump or basal bark treatment of woody shrubs, and
C. the wand-applicator method that directly wipes herbicide on targeted foliage.

Because contact with non-target plants is highly unlikely, these methods will have very few undesired effects on non-target plants.

The foliar spray method is slightly less direct and selective. This method, which typically uses a hand-held or backpack sprayer, directs a narrow stream of herbicide on the target plant with minimal drift. And although there is some possibility that non-target plants can be sprayed with herbicide, the spray from backpack sprayers can be carefully controlled by drift guards and nozzle selection in order to produce a wide range of droplet size and spray-pattern size.

A boom applicator consists of a long horizontal tube, with multiple spray heads, that is mounted or attached to a tractor, OHV, or other vehicle (aerial applications are prohibited). The boom is carried above the weeds while spraying herbicide, which allows large areas to be treated rapidly with each sweep of the boom. Offsite movement due to vaporization or drift and possible treatment of non-target plants can be of concern when using this method.

A skid sprayer, or skid-mount sprayer, is designed for applying herbicides via a hose with spray wand. A typical unit consists of a truck or OHV-mounted tank and retractable hose reel that allow a manual application of herbicides with the hose and spray wand. A skid-sprayer is more versatile than a boom sprayer, and allows more accurate application of herbicides.

To minimize this risk of herbicide drift from foliar spray methods, herbicide application will only occur when wind speeds are less than 10 mph to reduce herbicide drift, and when heavy rain events are not anticipated (project design criteria).

2. Application Conditions. Weather conditions can affect the potential for herbicides to affect non-target plants. Windy days can cause spray drift, and heavy rainfall can wash herbicides off treated plants and carry them in surface runoff to non-target plants. To minimize this risk, herbicide application will only occur when wind speeds are less than 10 mph to reduce herbicide drift, and when heavy rain events are not anticipated (see General Herbicide Application section of the project design criteria).

3. Season of Application. Application of herbicide during the growing season can kill or injure non-target plants if the application method is not selective. project design criteria limit foliar herbicide spray in areas that are not heavily infested to times of the year when native plants are dormant, such as very early spring or late in the fall, whenever possible. At those times, the native plants are less susceptible to herbicide damage. For example, garlic mustard, Japanese honeysuckle, bush honeysuckle, multiflora rose and Autumn olive are actively photosynthesizing in late fall and very early in the spring while most native plants are dormant. Therefore, application of a foliar herbicide during those times will kill the NNIP while leaving most native plants unaffected.

Herbicide may also be applied during the growing season in order to respond quickly and effectively to the detection of a recently discovered, highly invasive NNIP or to impact NNIP when they are most vulnerable. This situation may temporarily harm some native species but will benefit those species in the long run by eliminating NNIP before they have an impact on natural communities.

4. Choice of Herbicide. Some herbicides are more selective than others are. For example, clopyralid is the most selective herbicide among those proposed in this alternative. Although effective against many broadleaf plants, it is most selective toward members of the sunflower (*Asteraceae*), buckwheat (*Polygonaceae*), and pea (*Fabaceae)* families. Triclopyr is a broadleaf-specific herbicide, and therefore has little effect on grasses and other monocots. Sethoxydim is a narrowleaf-specific herbicide that targets monocots, such as grasses, but has little effect on broadleaf species. Use of these selective herbicides will leave more nontarget, native plants unaffected than a non-specific herbicide such as glyphosate or 2,4-D.

Very often, application of herbicide mixtures is necessary to obtain a desired degree of NNIP control. This is especially true where diverse vegetation is present on a site. Although any combination of herbicides can be legally mixed if each is labeled for the intended application and the mix is not prohibited by any of the labels, it is important to select compatible products and mix them properly. Labels provide recommendations on acceptable herbicide combinations and instructions for mixing.

Improper herbicide mixing may result in phase separation or even herbicide deactivation (e.g., when mixing glyphosate and triclopyr).

On the other hand, certain herbicides may be more effective when applied together. For example, there is a documented synergism between fluroxypyr and triclopyr that results in improved control of key woody species. When mixing herbicides, one must use the most restrictive limitations as specified on the labels of the particular products.

When applying herbicides to areas over or adjacent to water (including wetlands), use of herbicides and surfactants (and other adjuvants) specifically approved for aquatic use or use near water would be allowed. In general, adjuvants (particularly surfactants) will not improve herbicide effectiveness against submerged aquatic weeds, but they may be important for use on emergent aquatic and riparian plants. A factor to consider is that certain adjuvants or adjuvant mixes may sometimes be more toxic to certain non-target organisms than the herbicide itself. For example, the surfactant included in RoundUp® is more toxic to fish than the active ingredient glyphosate. For this reason, it is not legal to use RoundUp® over water bodies, but glyphosate formulations sold without a surfactant (e.g. Rodeo®) are legal in aquatic situations. Generally, formulations of herbicides that have a low water solubility and low persistence are safe to use near water. The following table lists the herbicides that are approved for use in or near water.

Table 5 Herbicides approved for use in or near water

Chemical Name	Commonly used brand names
Glyphosate	AquaMaster
	AquaPro
	Rodeo
	Accord
2,4-D	Banvel
Endothal – Aquatic Herbicides	Aquathol
	Hydrothol
Triclopyr	Garlon 3A
Imazapyr	Arsenal
	Habitat

5. Operator Training. All herbicide applicators either will be certified herbicide applicators or supervised by certified herbicide applicators. At NNIP sites where herbicide treatment must occur during the growing season, applicators must be able to distinguish between target NNIP and non-target species. Herbicide solutions will be mixed in appropriate locations to prevent the potential for spills in naturally vegetated areas. Spray equipment will be inspected, and calibrated, prior to each day's use to minimize the potential for leaks or misdirection of spray streams (Appendix C).

The application of Project Design Criteria, in combination with the five factors described above, will greatly minimize the effects of control actions on non-target, native vegetation. Herbicides are proposed on only 11% of the known NNIP infestations and 0.2% of the project area. Although herbicide use may kill some individual native, non-target plants in the short term, the overall long-term effect to the native plant community will be positive because it will prevent the loss of species diversity and natural community integrity due to uncontrolled NNIP spread.

Biological Control: Six insects and one fungus are proposed as biological control agents (Table 6). While it is true that all but one of these biological control agents are not indigenous to the United States, all have extensive and successful records of prior use in the United States (Van Driesche et al. 2002). They have all been permitted for use by USDA Animal and Plant Health Inspection Service (APHIS) under the Plant Protection Act of 2000 (7 USC 7701 et seq.). Before permitting the release of nonindigenous biological control agents, APHIS thoroughly evaluates the potential risk of adverse impacts to non-target plants and animals (USDA APHIS 2004a & 2004b). Plant Protection and Quarantine (PPQ), a branch of the APHIS. PPQ is the responsible for issuing permits to import, transport, and release insects into the United States. Associated with APHIS-PPQ is a group of professionals called the "Technical Advisory Group on the Introduction of Biological Control Agents of Weeds" (TAG), which is responsible for advising APHIS-PPQ about the accuracy and completeness of the host-specificity testing.

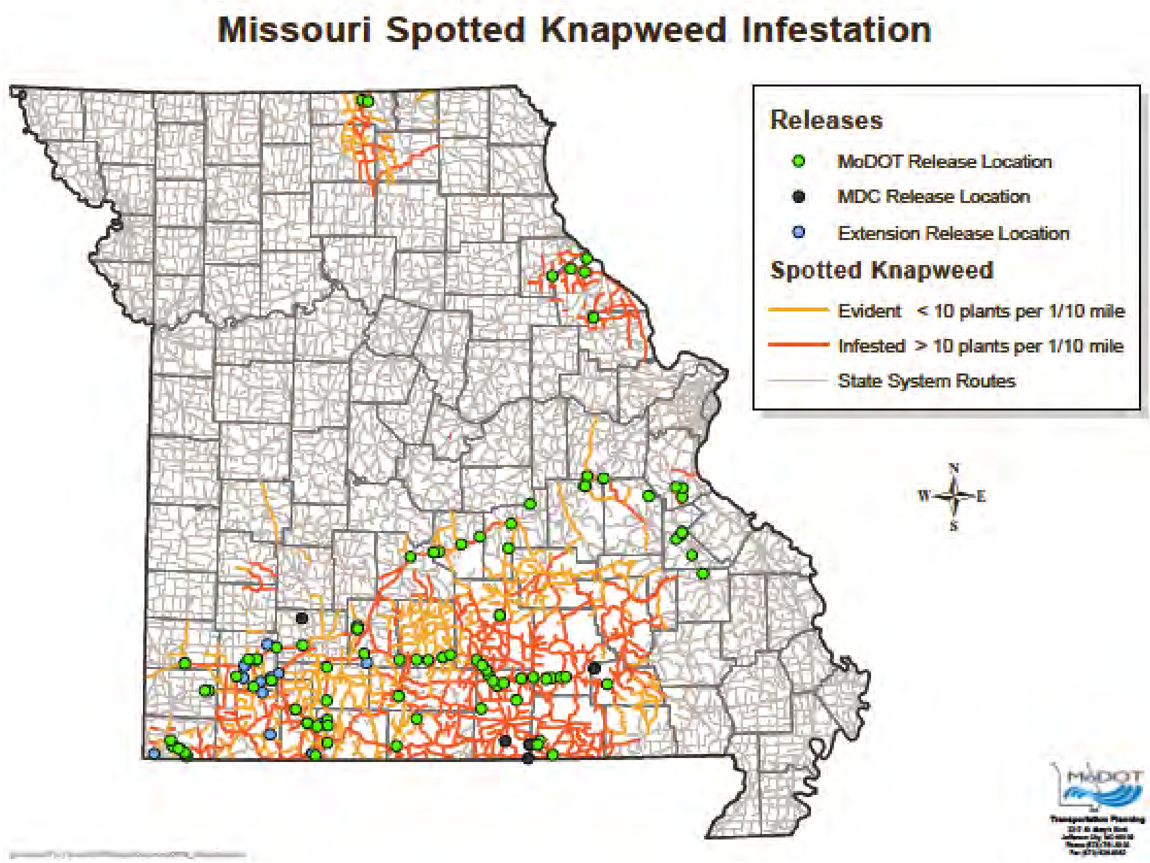
Table 6. Biological control agents proposed for use under Alternative 2.

Biological Control	Scientific Name	Target Plant
root weevil	*Cyphocleonus achates*	Spotted knapweed
seed head weevils	*Larinus minutes, Larinus obtusus*	Spotted knapweed
a rust fungus	*Puccinia carduorum*	musk thistle
black-dot leafy spurge flea beetle	*Aphthona nigriscutis*	leafy spurge
brown-legged leafy spurge flea beetle	*Aphthona lacertosa*	leafy spurge
copper leafy spurge flea beetle	*Aphthona flava*	leafy spurge
milfoil weevil	*Euhrychiopsis lecontei*	Eurasian water-milfoil

Seed head weevils (*Larinus minutes, Larinus obtusus*) and Root weevil (*Cyphocleonus achates*) Larinus minutes and Larinus obtusus are small, black soft seedhead weevil introduced in the United States in early 1990s. The weevils has been released in Arizona, California, Colorado, Idaho, Minnesota, Michigan, Montana (established), Nebraska, Oregon (established), South Dakota, Utah, Washington (established), Wisconsin and Wyoming (established) as a part of a biological control program to control spotted and diffuse knapweed.

Biological control of spotted knapweed in Missouri, begun in 2008 and involved the release of two weevils (*Larinus minutus/obtusus*) and root borer weevils (*Cyphocleonous achates*) that are host-specific to the spotted knapweed. Seedhead weevils, were released at over 200 sites in Missouri with approval from AHPIS-PPQ.

These releases were made by the Missouri Department of Transportation, Missouri Department of Conservation, and University of Missouri Extension. It will take several years for populations of these insects to grow enough to begin providing significant control of the spotted knapweed.



In regards to Issue B, there has been no analysis of the effects on non-target plant species within the State of Missouri.

Under Alternative 2, use of root weevil and seed head weevils are proposed. As previously discussed, biological control of spotted knapweed in Missouri, began in 2008 with the release of root and seed head weevils. Many of the release sites have been adjacent to NFS lands.

APHIS conducts extensive host specificity tests is to determine the host range of a potential biocontrol agent by exposing it to representative plant species. The plants tested are selected from a centrifugal (concentric circle) plant matrix with the target weed as the center, representatives of other species from the same subgenus as the first ring surrounding the center, representatives of species from other subgenera but within the same genus as the second ring, representatives from species of related genera of the same tribe as the next ring, and so on, with plants in each additional ring being less related to the target weed. In the next-to-last outer ring are plant families of economic or aesthetic value, but generally of no close relationship. The last ring includes unrelated plants with biochemical or morphological characteristics in common with the target weed, and plant species known to be attacked by close relatives of the biocontrol agent being tested.

Host testing for *Larinus minutes, L. obutsus* and *Cyphocleonus achates* included over 40 test plant species per insect. Most of the plant species were from the family A*steraceae*, but representative species from one or more other families also tested. *Emphasis* was placed on plants in the *Asteraceae* tribe *Cardueae* that includes the genus *Centaurea*. The plants of economic importance included in the tests were *Carthamus tinctorius L.* (safflower), *Helianthus annuus L*., (common sunflower), and *Cynara scolymus L*. (globe artichoke). None of the insects oviposited or fed on any of these three plants except for *Cyphocleonus achates* adults that fed slightly on artichoke. The feeding by *C. achates* was not of concern, however, because no eggs were laid on the plant. In general, attack by all of the insects was restricted to the genus *Centaurea*, and usually to the subgenus *Acrolophus*. There has been no report of attack on non-target species by any of the insects since release, although specific surveys have apparently not been conducted (Bargeron et al 2003).

Native species that are closely related to the target species are the most likely to be attacked (Louda et al., 2003). In North America, plants most closely related to spotted knapweed include safflower (*Carthamus tinctorius L.)* and possibly the two "knapweeds," *Centaurea americana* and *Centaurea rothrockii*. Recent evaluations, however, suggest the latter two plants should be treated as *Plectocephalus americanus* (Nutt.). The next closest relatives of spotted knapweed are members of the tribe *Cardueae*, mainly *Carduinae* (*Cirsium* and *Cynara* [e.g., artichoke]). There are numerous *Cirsium* species native to North America (Bargeron et. al. 2003).

In Missouri, *Centaurea Americana* (American basket flower) is the only native plant that is in the same genus as spotted knapweed, which these weevils would have the greatest potential to impact. American basket flower is common in Oklahoma, Texas, and New Mexico but uncommon in Missouri, primarily limited to the southwest portion of the State. The Missouri Department of Conservation list the American basket flower as a occurring historically in the state (Mo. Species and Communities of Conservation Concern 2011). It is usually associated with glades, openings of mesic to dry upland forests, pastures and roadsides (Flora of Missouri, 2011). This species was included in host testing for *Larinus obtusus.* Result of the host testing to *C. Americana* showed that the insect consumed foliage of the plant but did not support larval development and did not lay eggs on the plant (per comm. Karen A. Walker, APHIS, 2011)

Populations of American basket flower are generally in small-scattered populations. Native *Cirsium* to Missouri, include *C. carolinianum*, *C. discolor*, *C. muticum*, *C.undulatum* (Flora of Missouri, 2011). These native thistles are all known or have the potential to occur on the MTNF. Most are generally scattered and relatively uncommon.

Rust fungus (*Puccinia carduorum)*. This rust was accidentally introduced to North America and was the first plant pathogen tested and released in the United States for biological control of musk thistle. In greenhouse tests, limited infection occurred on some species of *Cirsium*, *Cynara*, *Saussurea*, and *Sylibum*, but older plants were resistant. Attempts to maintain *P. carduorum* on 22 native North American species of *Cirsium* and *C. scolymus* failed. Musk thistle was the only host that became severely diseased (Politis *et al.*, 1984 ; Bruckart *et al.*, 1996). No rust development was observed on any of the non-target plants (10 North American Cirsium spp. and artichoke) in a field trial carried out in 1988 in Virginia (Baudoin *et al.*, 1993). *Puccinia carduorum* has not been reported from native North American *Cirsium* species. It spread rapidly in the eastern United States and was found in Missouri in 1994 (Baudoin and Bruckart, 1996). By 1997, it was detected in 37 counties in Missouri. Although the disease does not kill the plant or reduce its seed production, it coexists with the musk thistle weevils and apparently does not interfere with their feeding on the thistle.

Leafy spurge flea beetles. The Brown-legged leafy spurge flea beetle (*Aphthona lacertosa*), the copper leafy spurge flea beetle *(Aphthona flava*) and the Black dot leafy spurge flea beetle (*Aphthona nigriscutis*) have been used as biological control agents targeting leafy spurge for more than twenty years in western rangelands (Anderson et al. 1999). Quarantine testing has shown that *Aphthona* flea beetles are very host specific and feed only on a narrow range of hosts restricted to the spurge family (Bourchier 2006). A potential risk to the few native plants in the genus *Euphorbia* is, however, acknowledged (Weeden et. al. 2008). The only known non-target plants fed upon by the proposed beetles is in the subgenus *Esula* of the genus *Euphorbia*. In Missouri, the sub-genus *Esula* is represented by the following species: *Euphorbia commutata*, *Euphorbia cyparissias*, *Euphorbia esula*, *Euphorbia obtusata*, and *Euphorbia spathulata*. *Euphorbia commutata*, *E. obtusata*, and E. *spathulata* are native species and are known to occur within the cumulative affects area. However, none of these species are federally listed as threatened or endangered, RFSS or state-listed.

Milfoil weevil. Unlike the other proposed biological control agents, the milfoil weevil is indigenous to the United States, including Missouri. It can be released legally at sites in the United States without quarantine studies and APHIS approval and is recognized as offering reduced risk to non-target vegetation and distinct logistical advantages over biological control agents introduced from other parts of the world (Sheldon and Creed 1995). The milfoil weevil feeds specifically on water-milfoil plants (*Myriophyllum spp*.), and traditionally feeds on the native northern water milfoil (*Myriophyllum sibiricum*). However, upon introduction it will feed on Eurasian water milfoil (Sheldon and Creed 1995). It is possible that the introduction of the milfoil weevil to waters presently free of the species could result in long-term suppression of any native[2] water-milfoil populations as well as the targeted Eurasian water milfoil. However, any reductions in native populations of water-milfoils would be minor compared to the long-term benefits to native vegetation as a result of Eurasian water-milfoil control.

Cultural Control: Cultural control methods include the use of competition, grazing mammals, scorching, smothering, and Waipuna® hot foam.

[2] There are five species of milfoils in Missouri (Flora of Missouri Project, 2008), and while three of these are native (*Myriophyllum aquaticum, M. heterophyllum*, and *M. pinnatum*) and are known to occur within the cumulative effects boundary, none are Federal or State listed, or considered to be Regional Forester Sensitive Species.

Competition: Competition involves planting native perennials (typically warm-season grasses) on treated infestations. If managed properly, in most situations the native perennials will colonize the site and out-compete the NNIP.

Grazing: Grazing involves the use of mammals, such as cows, goats, and sheep, to control certain NNIP. By itself, grazing will rarely eradicate NNIP from a particular infestation. However, when grazing treatments are combined with other control techniques, such as herbicides or mowing, severe infestations can be reduced and small infestations may be eradicated. In accordance with the Mark Twain National Forest Land and Resource Management Plan (USDA Forest Service. 2005a), “grazing of livestock other than cattle and horses may be used for biological control of NNIP.” However, the Mark Twain National Forest Land and Resource Management Plan (USDA Forest Service, 2005a) also places the following restrictions on grazing:

- Grazing is not allowed within 100 feet of springs, significant seeps, fens, other wetland features or the break of a sinkhole basin.
- Grazing is allowed within the RMZ only under the following conditions: Livestock are fenced at least 100 feet away from stream banks;
- Grazing shall not be allowed to degrade the RMZ or WPZ, or their functionality.

Scorching: Use the flame of a propane weed torch to scorch or wilt green leaves. This is done either very early or late in the growing season when exotics are green and native perennials are mostly below ground. It does not start a ground fire. Scorching will kill one year’s growth of annual and biennial weeds. This is especially useful for garlic mustard, beefsteak plant, and Japanese stiltgrass.

Smothering: Smothering small infestations with mulch (hay, grass clippings, wood chips, etc.) or other type of ground cover (newspaper clippings, plastic sheeting) prevents weed seeds and seedlings from receiving sunlight necessary to survive and grow.

Waipuna® Hot Foam: The Waipuna® Hot Foam system is comprised primarily of a diesel-powered boiler and foam generator, which deliver hot water with a foam surfactant to target weeds via a supply hose and a treatment wand. The superheated hot foam is applied to the targeted vegetation at a precise temperature (93 degrees C, 200 degrees F) and pressure; the foam traps the steam, giving it time to "cook" or "blanch" the vegetation. This causes a cellular collapse of the treated aboveground vegetation. This control method is limited in mobility and is best used near developed sites such as work centers, campgrounds, trailheads, and along some roadsides.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

Direct, Indirect and Cumulative Effects -This alternative is the same as Alternative 2 (proposed action) except that MTNF would not use any herbicides. All NNIP treatments under this alternative would be manual, mechanical, cultural or biological methods. This alternative is expected to be less effective and more costly to implement. The increase in manual, mechanical, and cultural control is not expected to have substantial increased effects to non-target vegetation over those in Alternative 2.

RESPONSE TO ISSUE B

In the current NNIP inventory, there are 23 sites of spotted knapweed with an average infestation size of 34 acres, where seedhead and root weevil are identified as possible suitable sites for release. Most of these proposed sites are located in counties that University of Missouri Extension, MDOT and MDC have already completed releases (http://extension.missouri.edu/webster/spottedknapweed/).

Based on the host testing, extensive use in the past 30 years in the western states and more recent use in the upper Midwest in the past 10 years it is not likely that release of these biological control agents would have a significant impact on populations of native *Centaurea* or *Cirsium* species within the State. However, once a biological control agent is released into the environment and becomes established, there is a slight possibility that it could move from the target plant to attack nontarget plants, such as the native plant *Centaurea americana*. Host shifts by introduced weed biological control agents to unrelated plants are rare (Pemberton, 2000).

RESPONSE TO ISSUE C

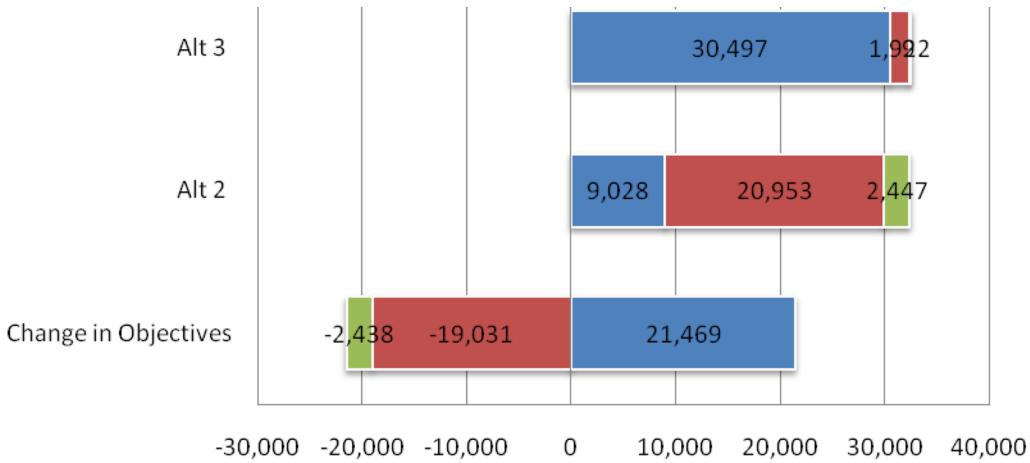
In regard to Issue C, there is a concern about the Forest's ability to eradicate certain NNIP populations without the use of herbicides. Under Alternative 2, herbicide use is identified as a suitable method treatment on roughly 3,652 acres of infestation. This represents approximately 11% of the mapped and inventoried infestations. With the use of herbicides in combination with manual and mechanical treatments in Alternative 2, the ability to achieve eradication or reduction objectives on more acres of NNIP infestations would have a higher percentage of success. For Alternative 2, a treatment objective of eradication has been assigned on about 2,447 acres (8%) of existing NNIP populations. Herbicide use is identified as a treatment method to eradicate these populations.

All newly discovered infestation that are detected early enough and are relatively small (< 1 acre) in size would be rapidly targeted for eradication, especially if those infestation that are highly invasive, are a threat to native plant communities and specialist habitats, and can easily and economically be eradicated. In most cases, this would involve an integrated use of manual, mechanical and herbicide treatments.

Alternative 3 forgoes the use of herbicides thus reducing the amount of NNIP infestations eradicated by 2,438 acres. Without the use of herbicide, only 9 acres could be eradicated without herbicides. Approximately 30,497 acres (94%) would be placed in a containment strategy compared to Alternative 2, which would be 9,028 acres (27%). The ability to reduce NNIP infestations effectively would go from 1,922 acres (6%) in Alternative 3 to 20,953 acres (65%) in Alternative 2.

Controlling NNIP infestation in Alternative 3 would not be nearly as effective as Alternative 2. Effective eradication of newly discovered infestations is likely to be compromised without the use of herbicide. In addition, Alternative 3 has an opportunity cost by requiring the Forest to focus limited resources on containment strategies year after year rather than focusing on eradication efforts.

Figure 4 Comparison of treatment objectives of existing NNIP by Acres



	Change in Objectives	Alt 2	Alt 3
Contain	21,469	9,028	30,497
Reduce	-19,031	20,953	1,922
Eradicate	-2,438	2,447	9

CUMULATIVE EFFECTS ON VEGETATION

The cumulative effects analysis area for vegetation is the MTNF proclamation boundary. This analysis area was chosen because it includes areas proposed for NNIP treatment under Alternative 2 and 3. This area would also include any lands that have yet to be acquired by the Forest Service, but which may need rapid response treatment to reduce NNIP. The cumulative effects analysis timeframe is 10 years, because this coincides with the Forest Plan planning cycle and this timeframe allows for initial and subsequent treatment of NNIP infestations.

To date there are several on-going projects on the MTNF that include NNIP control. On the Potosi Ranger District, the Shoal Creek Project will use herbicides on 62 acres for riparian and savannah restoration, as well as NNIP control. The Houston-Rolla Ranger District has three projects (Crescent, Fairview, and Middle River) that will use herbicides for NNIP control, and fescue conversion[3] to native, warm-season grasses. The control of NNIP in these project areas is primarily through chemical means, although mechanical equipment has been used to grub out autumn olive on the Cedar Creek unit, and grazing with cattle is routinely used on the Mark Twain NF to control sericea lespedeza in range allotments. Mowing permits are also used in range allotments to control the spread of some NNIP such as sericea lespedeza, spotted knapweed, and musk thistle. Finally, the MTNF applies a small amount of herbicide

[3] Fescue conversion involves the eradication of fescue (*Festuca arundinacea*) and the subsequent replanting of native, warm-season grasses such as big bluestem (*Andropogon gerardi*) and switchgrass (*Panicum virgatum*). These native grasses are more favorable to the continued survival of the native flora and fauna on the MTNF.

to control poison ivy in recreation areas and administrative sites such as work centers and office buildings.

Control of unwanted vegetation occurs on non-federal lands in the cumulative effects analysis area. Some manual applications of herbicides occur on utility rights-of-way and easements, and truck-mounted boom sprayers are used to apply herbicides along county and state roadsides. Many private landowners use herbicides, and most farmers apply herbicides and fertilizers to crops and pastures, although no data are available that provide details on these uses. Mechanical control of vegetation on non-federal lands primarily involves private landowners that hand-weed or mow weeds, farmers that mow or till weedy areas and crews that mow and/or cut trees along rights-of-way and easements. While some of these applications may target NNIP, many are employed to control species that are not considered invasive. These chemical applications and soil/vegetation disturbances are likely to continue into the future on non-MTNF lands at rates similar to today, but aside from the Missouri Department of Transportation (MODOT) and Ameren UE, the amount and extent of such activities is unknown.

As education and information outreach efforts continue, there may be more NNIP treatment on non-federal lands. However, herbicides to treat NNIP may be cost-prohibitive to many private landowners. Mechanical, biological, cultural or chemical control measures would not be used under Alternative 1, therefore this alternative would not contribute to any adverse cumulative impacts to non-target vegetation. However, failure to control NNIP on NFS lands could indirectly contribute to a cumulative decrease in native non-target plants during the cumulative effects analysis time period. (http://www.fws.gov/Midwest/planning/marktwain/final_ch4.pdf)

Cumulative Effects - The treatment actions in the proposed action are expected to result in a reduction of NNIP at the sites shown on maps currently posted on the Mark Twain National Forest website (http://www.fs.fed.us/r9/forests/marktwain/projects/projects/00601/) as well as any unknown infestations, and will lead to a reduction of NNIP infestations and spread on the Forest. The Project design criteria, application method, application conditions, season of application, choice of herbicide (based on selectivity), and operator training will be carefully controlled in order to reduce any adverse affects on non-target plants.

The amount of herbicide that would be added to the environment would be insignificant compared to amount of herbicide being applied to other lands within the cumulative effects area. Aside from the Missouri Department of Transportation, no comprehensive data on herbicide use were available from other government agencies. A detailed analysis of the data provided by the Missouri Department of Transportation revealed herbicide use is documented in the project record.

For example, if the MTNF were to annually treat 1,000 acres of NNIP with glyphosate,[4] the MTNF would be adding an additional 250 lbs per acre per year (or 62.5 gallons - which is 11% of the amount applied by MODOT) to the environment. The MTNF would not treat all infestations with herbicide, nor is it likely to have

[4] Acres are treated with a typical application of 0.25 lbs glyphosate/acre (a 6.25% solution of 8 fl. Oz. in 10 gallons water/acre of Round-Up Pro which has 4 lbs. of active ingredient in 1 gallon).

funding to treat all infestation in one year, so the cumulative impact within the cumulative effects area would be much less than that stated above.

The figures above do not factor in the amount of herbicide being applied for home/garden use. In 2000 and 2001[5], U.S. home-owners and gardeners accounted for 11 and 13 percent of herbicide sales respectively (62 and 71 million pounds of herbicide, respectively) (Environmental Protection Agency, 2004.) The amount of herbicides applied for home/garden use is larger than commercial, industry and government sales combined (9% in both years, or 49 million pounds) (Environmental Protection Agency, 2004). Because herbicide impact on non-target plants and natural communities is expected to be relatively small and because the MTNF will contribute only a fraction of the herbicide to the environment in the cumulative effects area, herbicide treatments will contribute only a small, adverse, and incremental effect when combined with impacts of other past, present and reasonably foreseeable future activities described in Alternative 1. Therefore, herbicide use in Alternative 2 is not expected to result in adverse cumulative effects to non-target plants and plant communities.

The effects from manual/mechanical control activities on non-target plants and natural communities is expected to be minimal, and thus will have little or no incremental effect when combined with the impacts of other past, present, and reasonably foreseeable future activities described in Alternative 1. The effects of biological control agents on non-target species are also considered minimal in this alternative and would therefore have little or no incremental effect when combined with the impacts of other past, present, and reasonably foreseeable future activities. Although non-target native plants could be affected by the control activities in this alternative, there is a far greater potential for loss of these species and their habitats if no treatment occurs and NNIP continue to spread.

Finally, mowing would be useful to prevent seed set of NNIP species such as non-native grasses, thistles, and knapweeds. In the case of annual NNIP, mowing could be effective in eliminating a species and its seedbank by stopping seed-set. In locations with perennial NNIP, mowing is an effective tool to prevent seed production and spread, thus containing an infestation.

SOIL RESOURCES

AFFECTED ENVIRONMENT

The project area is the Mark Twain National Forest, which lies within a variety of ecoregions across southern MO. The forest covers rolling lowlands to deeply dissected uplands and bluff lands. The diverse landscapes are strongly influenced by the underlying geologies. Most soils developed in loess, cherty limestone, and sandstones. Soils are generally old, shallow, stony, highly weathered, and acidic, except on some broad ridges and bottomlands. Soils on some of these broad ridges and bottomlands tend to be neutral to slightly alkaline compared to other soils (USDA Forest Service 1999). The soils of the Mark Twain National Forest can also be very

[5] This is the latest version of the report. According to Kiely (2008) the next version was due in the Spring of 2008, but has yet to be published.

deep, well-drained mineral soils, which have formed in residuum and colluvium from local sandstone and dolomite bedrock. Alluvial soils, consisting mainly of stratified silt, sand, and gravel, are usually found on valley floor floodplains. These soils are usually well drained, although valley bottoms and areas with perched water tables can have areas of poor drainage. Some soils, particularly those on steeper ground, have very gravelly or stony surfaces and are skeletal (more than 35 percent rock fragments by volume) throughout the profile.

Soils of the Mark Twain National Forest can also be moderately well drained to well drained and have moderate to slow permeability. Most of the soils are developed in loess (a loamy material derived from glaciers and transported by the wind) and in residuum from cherty limestone, dolomite and sandstone. The soils are generally old, stony, highly weathered and acidic, except on some broad ridges and bottomlands. Some soils on broad ridges and bottomlands are loamy, neutral to slightly alkaline and more fertile than other soils in the area.

The Cedar Creek unit straddles Boone and Callaway counties, and is within the Outer Ozark Border (OZ12) and the Claypan Till Plains (TP6) subsections of the Missouri Ecoregions (Nigh and Schroeder, 2002). The OZ12 subsection occurs in deeply dissected hills and bluff lands bordering the Missouri and Mississippi Rivers. The subsection includes a variety of underlying geology, but the most distinct is the cherty dolomite of the Mississippian Burlington Formation (Nigh and Schroeder, 2002). Soils of this subsection formed in loess deposits over cherty dolomite residuum, and include the Menfro, Wrengart, and Goss series. The TP6 subsection is underlain by horizontally bedded Mississippian and Pennsylvanian aged sedimentaries, but are rarely exposed on the soil surface (Nigh and Schroeder, 2002). The soils in this subsection are distinguished by the presence of well-developed claypan soil on a flat glacial till plain. Common soils of the TP6 subsection are the Leonard and Putnam series.

The Houston-Rolla Ranger District covers portions of Pulaski, Phelps, and Texas counties. The district is within the Gasconade River Hills subsection (OZ7) of the Ozark Highlands. Most of the subsection is underlain by dolomites and sandstones of the Gasconade and Roubidoux Formations; while the ridge-tops are dominated by dolomites of the Jefferson City-Cotter Formation. The soils of the subsection are generally deep and well drained. The Clarksville and Gatewood series are common within the subsection.

The Ava-Cassville-Willow Springs units are within the White River Hills (OZ4) and Central Plateau (OZ5) subsections. Most of the soils of the area are weathered from the cherty dolomites and sandstones of the Roubidoux and Jefferson City-Cotter formations. Soils with root restricting fragipans are common on broad ridge tops throughout the area. The Tonti, Scholten, and Clarksville series are typical in this part of the state.

The Eleven Point Ranger District covers portions of the Central Plateau (OZ5) and the Current River Hills (OZ9) subsections. The area consists of deeply dissected sections of the Current, Black, and Eleven Point river drainages (Nigh and Schroeder, 2002). The soils that formed from the Roubidoux Formation are generally low in soluble bases and very deep. The Coulstone and Clarksville soil series are common to the formation. The more base rich Rueter and Scholten series are common in the Gasconade and Eminence-Potosi Formations.

The Black River Ozark Border subsection (OZ14) is home to the Poplar Bluff Ranger District. The OZ14 subsection consists of moderately dissected hills and flatwoods. The soils in the area are mostly deep and formed from Gasconade and Roubidoux dolomites. The Captina and Poynor soil series are common to the area.

The Fredericktown unit lies within the St. Francois Knobs and Basins subsection (OZ10). The area is characterized by the presence of Precambrian aged igneous rocks that have been exposed by erosional forces. The igneous knobs are often interconnected by Cambrian aged remnants of LaMotte sandstone, Bonne Terre dolomite, and Potosi and Eminence cherry dolomites (Nigh and Schroeder, 2002). Soils formed over igneous residuum are moderately deep and acidic, with low amounts of soluble bases. Knobtop and Irondale soils are common within these areas. The Wilderness and Clarksville soil series are common to areas with limestone residuum.

The Salem and Potosi Ranger Districts are within the Meramec River Hills (OZ8), Current River Hills (OZ9), and the St. Francois Knobs and Basins (OZ10) subsections. The area is dominated by sandstones and dolomites of the Eminence-Potosi, Roubidoux, and Gasconade formations. Soils that formed from Roubidoux residuum include the Viburnum and Tonti series; they are generally low in exchangeable bases. Soils formed over Gasconade and Eminence-Potosi remnants are higher in soluble bases, and include the Rueter and Hildebrecht series.

Detailed county soil surveys for the MTNF are available online at: http://websoilsurvey.nrcs.usda.gov/app/

DIRECT AND INDIRECT EFFECT ON SOIL RESOURCES

ALTERNATIVE 1 – NO ACTION

Under alternative 1, the Forest Service would not implement the proposed action or any other alternative to control existing and future NNIP infestations. However, there would still be some small-scale NNIP control activities such as mowing, grazing, and spot herbicide applications conducted on the MTNF. Given the number of existing NNIP infestations on the MTNF, selecting the no action alternative would likely lead to increased infestations.

This alternative would not result in any immediate adverse impacts to soils. However, NNIP infestations can adversely impact soils by removing nutrients that would otherwise be available to native plants. Invasive plants can also change soil chemical properties through allelopathy (Tyrer et al., 2007). Spotted knapweed for example, secretes a phytotoxin into the soil that prevents native plant establishment (Bais et al., 2002). Invasive plants can cause changes in soil properties, displace an existing wildlife food source, and alter erosion and sedimentation processes (Westbrooks 1998). Therefore, failure to control NNIP infestations on the MTNF could eventually result in adverse impacts to soil resources.

ALTERNATIVE 2 – PROPOSED ACTION

The MTNF proposes to implement an integrated program for the prevention, eradication, suppression, and reduction of existing and future NNIP infestations on National Forest System lands within the Mark Twain National Forest boundaries. These control methods include various combinations of manual, mechanical, chemical, cultural, and biological treatments. These treatments are described in detail in Appendix C.

Under Alternative 2, some additional ground disturbing activities would occur. Some of the proposed mechanical and cultural control methods could temporarily increase the potential for soil erosion and compaction over relatively small sites; however, mitigation measures can reduce that potential. Further, the impacts from the proposed NNIP methods would be minimal when compared to other land management activities.

Cultural and Mechanical Control Methods

Dig: Very small areas of disturbed or bare soil could occur with this treatment, generally limited to the basal area of the individual plant. Areas where large numbers of plants are removed could be covered with nearby leaf litter to reduce the potential for soil erosion.

Disc: A tractor could potentially rut or compact the soil; heavy equipment should only be operated when soils are dry and on gentle slopes in order to prevent adverse impacts. In accordance with Design Criteria SW2, soil disturbance would be limited and exposed soils would be re-vegetated promptly to avoid re-colonization by NNIP. Considering the limitations of the equipment required for this treatment, it would occur on flat range/pasture settings. The anticipated impact to the soil resource from disking is negligible.

Grazing: Mammals such as cows, goats, and sheep would be used to control certain NNIP. By itself, grazing will rarely completely eradicate invasive plants. However, when grazing treatments are combined with other control techniques, such as herbicides or biocontrol, severe infestations can be reduced and small infestations may be eliminated.

Domestic livestock, such as cattle, goats, and sheep can be used to reduce specific NNIP populations. By itself, grazing would not provide complete eradication of a particular species but can reduce it to a manageable or economic level. When grazing is combined with other control methods such as herbicides, mowing or burning, eradication may be possible and less expensive than by one method alone. Goats would be the species of choice, especially for woody species such as, multiflora rose, sericea lespedeza, thistles, and kudzu.

Grazing cattle, sheep, or goats can cause damage to soil and vegetative resources if not managed properly. Overgrazing can reduce desirable plant cover, disturb soils, increase run-off and erosion potential, weaken native plant communities, and allow weeds to invade.

The MTNF currently utilizes permitted cattle grazing in combination with mowing on approximately 3,000 acres as a control measure for sericea lespedeza on the Cedar Creek Unit. Mowing is done to condition the sericea to make it more palatable for livestock use. This is done by utilizing intensive early stocking while sericea is young and has not set seed. Monitoring has shown that this is keeping plants from maturing, thus reducing viable seed bank in the soil and the rate of infestation. However, this treatment method has not eradicated any populations. Monitoring on the Cedar Creek unit has shown no substantial loss of soil productivity from current permitted cattle grazing activities.

There are two types of grazing treatments the Forest would use of controlling NNIP, pasture treatments and targeted treatments. Pasture treatment would utilize goats or sheep to browse specific NNIP, such as sericea lespedeza, in an existing active or vacant grazing allotment. This may be done in conjunction with on-going permitted cattle grazing. Targeted grazing treatment would consist of constructing temporary enclosure (usually electric fence) around an infestation, such as honeysuckle or kudzu and stocking the enclosure with goats. In some cases, the animals may be tethered and not fenced.

RESPONSE TO ISSUE A

Herbicide Application: Herbicides are used to control or eradicate unwanted vegetation. It is desirable for the chemicals to remain in the soil long enough to control weeds, but not so long that it becomes a pollutant. The amount of time that an herbicide remains active in the soil is known as persistence. Factors affecting the breakdown of an herbicide affect persistence. Many factors determine the length of time herbicides persist in soil; most factors fall into three categories: soil factors, climatic conditions, and herbicide chemical properties.

Soil factors affecting herbicide persistence include the physical, chemical, and microbial properties. Soil composition is a factor that measures soil texture and soil organic matter. Chemical properties of the soil include pH, cation exchange capacity (CEC), and nutrient status. Soil composition affects herbicide phytotoxicity and persistence through adsorption, leaching, and volatilization (Hager et al. 1999). Generally, soils high in clay or organic matter have a greater potential for herbicide persistence because there is increased binding with soil particles, with a corresponding decrease in leaching and loss through volatilization.

Some herbicides are affected by soil pH, an important part of the soil chemical makeup. Chemicals do not readily adsorb soil particles at higher soil pH, so they remain in the soil solution. Herbicides in the soil solution could then leach through the soil profile and move offsite. Chemical breakdown and microbial breakdown, two major herbicide degradation processes, are often slower in soils of higher pH. So although decreased adsorption of herbicides occurs in soils of higher pH, there would also be less degradation.

Degradation by soil microorganisms depend on the type and abundance of the soil microbes present. Soil microorganisms are partially responsible for the breakdown of many herbicides. The types of microorganisms and their relative amounts determine how quickly decomposition occurs. Soil microbes require certain environmental conditions for optimal growth and breakdown of any herbicide. Factors that affect microbial activity are temperature, pH, oxygen, and mineral nutrient supply. Usually, warm, well aerated, fertile soil with a medium soil pH is most favorable for micro-organisms and hence herbicide breakdown.

The climatic conditions influencing herbicide degradation are soil moisture, temperature, and sunlight. Herbicides degrade more rapidly as temperature and moisture increases due to higher chemical and microbial decomposition rates (Hager et al. 1999). Cool or dry conditions slow degradation, which could increase herbicide persistence. If winter and spring conditions are wet and mild, herbicide persistence is less likely. Sunlight plays a role in herbicide degradation as well; herbicides may be lost when applied to the soil surface and remain there for an extended time period without rainfall. Therefore, degradation is accelerated on very sunny days.

The chemical properties of an herbicide can also affect its persistence. Important factors include water solubility and susceptibility to chemical and microbial degradation. The solubility of an herbicide influences its leaching potential; leaching occurs when an herbicide is dissolved in water and moves down through the soil profile. Highly soluble herbicides may be carried to rooting zones of susceptible plants, or be moved offsite. Herbicide leaching is determined by both the herbicide's water solubility and its ability to bind to soil particles. Herbicides exhibiting low solubility are held strongly to soil particles, in addition, herbicides that exist in dry soils are less likely to leach and have a greater potential to persist.

The capacity of the soil to filter, buffer, degrade, immobilize, and detoxify herbicides is a function or quality of the soil. Soil quality also encompasses the impacts that soil use and management can have on water and air quality, and on human and animal health. The presence and bioavailability of herbicides in soil can adversely impact human and animal health, and beneficial plants and soil organisms. Herbicides can move off-site contaminating surface and groundwater and possibly causing adverse impacts on aquatic ecosystems.

Herbicide stays in the treated area long enough to produce the desired effect and then degrades into harmless materials. Three primary modes of degradation occur in soils:

- biological - breakdown by micro-organisms
- chemical - breakdown by chemical reactions, such as hydrolysis and redox reactions
- photochemical - breakdown by ultraviolet or visible light

The rate at which a chemical degrades is expressed as the half-life (Table 7). The half-life is the amount of time it takes for half of the herbicide to be converted into something else, or its concentration is half of its initial level. The half-life of an herbicide depends on soil type, its formulation, and environmental conditions (e.g., temperature, moisture). Other processes that influence the fate of the chemical include plant uptake, soil sorption, leaching, and volatilization (figure 5). If herbicides move off-site (e.g., wind drift, runoff, leaching), they are considered to be pollutants. The potential for herbicides to move off-site depends on the chemical properties and formulation of the herbicide, soil properties, rate and method of application, herbicide persistence, frequency and timing of rainfall or irrigation, and depth to ground water.

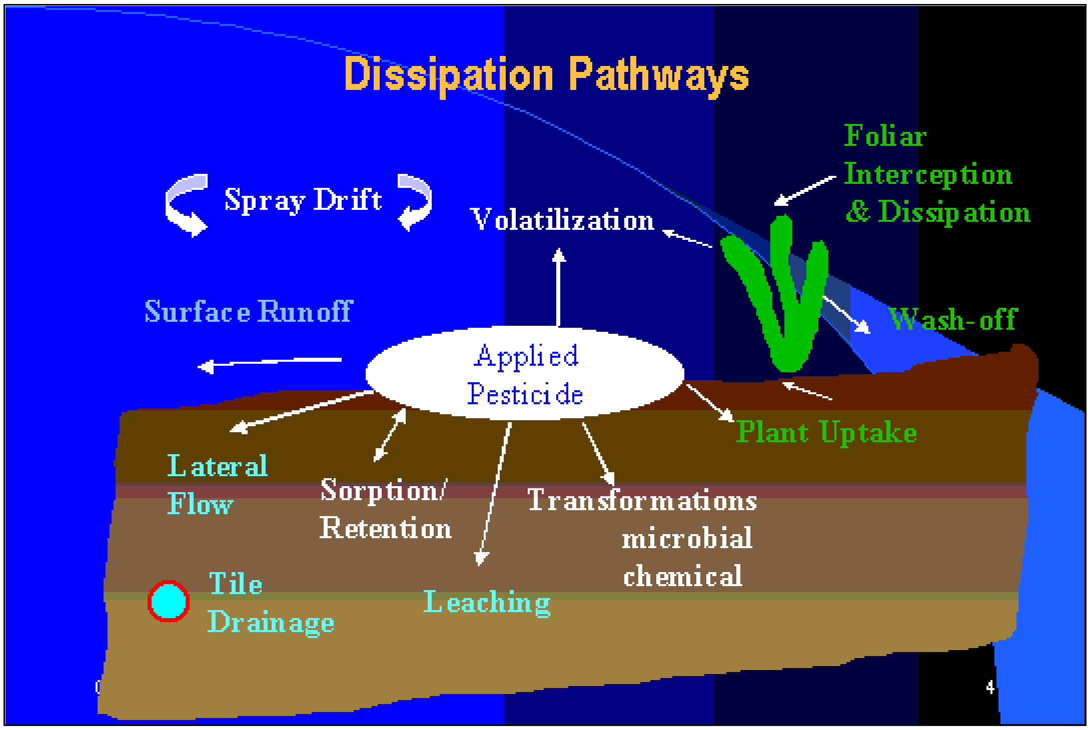


Figure 5 Field Dissipation (Degradation) Pathways (source EPA)

An important requirement of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C.136, et seq.) is the terrestrial field dissipation test. The purpose of terrestrial field dissipation studies is to determine the extent of pesticide residue dissipation (disappearance) under actual use conditions While the laboratory studies are designed to address one dissipation process at a time, terrestrial field dissipation studies address pesticide losses combined result of chemical and biological processes (e.g., hydrolysis, photolysis, microbial transformation) and physical migration (e.g., volatilization, leaching, plant uptake). Pesticide dissipation may proceed at different rates under field conditions and therefore may result information of derogates at levels different from those observed in laboratory studies (USEPA Technical Overview of Ecological Risk Assessment Analysis Phase: Exposure Characterization). Table 7 shows the mechanism of degradation, soil half-life and the range of dissipation from a variety of studies used by the EPA for pesticide registration and re-registration.

Table 7 Herbicide Characteristics in Soil (terrestrial)

Herbicide	Characteristics			
	Mechanism Of Degradation	Half-Life in Soil (days)[1]	Terrestrial Field dissipation half-life (days) [2]	Mobility in Soil
2,4-D	Soil Microbes	10 Days	14 days	Low to moderate potential to bind to soil, providing for moderate mobility.
Aminopyralid	Hydrolysis and Photolysis	31-533 Days	20 - 32 days	High
Clopyralid	Soil Microbes	40 Days	25 days	High
Dicambia	Rapid microbial degradation, slow photodegradation	7-42 Days: < 14 Days under optimum conditions.	16 days	High, but degrades rapidly.
Endothall	Hydrolysis and Photolysis	14 Days	14 days (terrestrial) 0.1-0.23 days in water	Aquatic herbicide.
Fluroxypyr (SERA. 2009b)	Soil Microbes and Hydrolysis	23 Days	36 days	High, but degrades rapidly.
FAS	Soil Microbes	8 Days	5 days	Readily binds to some soils, preventing mobility. Low
Glyphosate (	Soil Microbes	47 Days	1–180 days	Readily binds to soil, preventing mobility. Low
Imazapry	Soil Microbes and Photolysis	25-141 Days	25-180 days	High
Sethoxydim	Soil Microbes and Photolysis	5 Days	1-10 days	High, but degrades rapidly.
Triclopyr	Degrades rapidly due to photolysis, hydrolysis, and soil microbes.	30 Days	39-60 days	Ester formulation readily binds to soil, preventing mobility. Salt formulation binds weakly, providing for some mobility.

1. Source: Forest Service Human Health & Ecological Risk Assessments
2. Source: EPA Pesticide FACT Sheets and EPA Pesticide Fate Database

It is unlikely that chemical control would increase the potential for soil erosion because the method would kill but would not abruptly remove plants and their root systems. The dead plants would be expected to offer short-term soil stabilization to protect against erosion until new plants re-establish naturally, usually within two growing seasons. Sites requiring the use of a non-selective herbicide or disking would be mulched and re-seeded as needed. Disturbance size, slope, and landscape location would be considered to determine the appropriate action on a site-specific basis. Treating root stumps of woody NNIP species such as tree-of-heaven and autumn olive with herbicides would discourage re-sprouting without the soil disturbance required to grub out the stumps. This is also one of the chemical application methods, which does not result in chemicals coming in direct contact with the soil.

Most infested sites would receive foliar applied spot treatments, in an effort to limit the amount of herbicide sprayed directly on the ground. Large infestations in fields and along right of ways may receive foliar applied broadcast treatments with boom sprayers. Broadcast application will increase the herbicide loss potential on some sites. However, herbicides that do come in direct contact with the soil would leave some level of residue until it is degraded.

Once in contact with the soil, herbicides can persist until degraded by sunlight, water or microorganisms; and/or move offsite by leaching or surface runoff. Soil physical and chemical properties will influence how water infiltrates the surface and moves throughout the soil profile. The capacity of herbicides to accumulate in soil is controlled by the chemical formulation as well as soil and climatic factors (Hager et al. 1999).

Analysis of soil-herbicide interaction used WIN-PST3. This is a screening tool developed by the NRCS to evaluate overall potential for a specific herbicide to leach or runoff, based on properties of individual soils. Herbicide values considered are solubility, half-life, human toxicity, and fish toxicity. Soil factors such as slope > 15%, high water table within 24 inches of the surface during the growing season, presence of macrospores in the surface horizon deeper than 24 inches, texture of surface horizon, hydrologic soil group, Kfactor (erosion potential of surface horizon and its thickness), and organic matter percent of surface horizon are also considered. WIN-PST3 matches the selected herbicide and soil and returns ratings for potential for leaching, solution runoff, and adsorbed runoff ratings. The matrixes for soil/herbicide interactions can be found in Appendix D.

WIN-PST3 reports for this project's herbicides and soils are available at: Mark Twain National Forest – Projects and are incorporated by reference. The reports are generated by Forest Service unit and are several hundred pages and cannot be easily summarized and displayed in this document.

These reports are used to assist in the planning of herbicide applications for specific soil map units with NNIP infestation were herbicides will be used.

Aminopyralid is a relatively new herbicide with limited information on use in the field. Initial findings estimate aminopyralid to have a half-life ranging from 31 – 533 days, and high mobility regardless of soil type (U.S. EPA/OPP-EFED 2004, p.19). Despite the persistence and mobility, aminopyralid does not appear to be toxic to animals. Infestations that require highly mobile herbicides would need an additional assessment in order to determine site suitability.

Biological Control: Utilizing biological controls for NNIP would not result in any direct or indirect effects to the soil resource. Because there would be no direct or indirect effects associated with use of biological controls, there are no cumulative effects anticipated.

The treatments proposed in this project are not expected to reduce overall soil productivity on the MTNF. The 2005 LRMP mandates that all ground-disturbing activities be designed to minimize detrimental soil disturbance and loss of water quality. In addition, project design criteria have been developed to minimize effects as much as possible. Adhering to the 2005 LRMP Standards and Guidelines, and the project design criteria would allow for NNIP control with minimal detrimental soil disturbance.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

This alternative would allow control of NNIP population by utilizing manual, mechanical, biological, or cultural treatment methods only. No use of herbicides would be authorized. The use of three biological agents, root weevil and seed head weevils would also not be authorized.

The anticipated effects to the soil resource are similar to those discussed for Alternative 2. This alternative does not use herbicides, thereby eliminating any potential effects associated with herbicides leaching into surface or groundwater. Because no herbicides would be used, control of NNIP would need to rely on biological, mechanical, manual, and cultural methods. There would be much larger areas and amounts of soil disturbance. This would increase the risk of larger amounts of soil moving offsite into surface and ground water systems. Rutting and compaction of the soil will decrease soil productivity due to decreased infiltration of water and root development.

CUMULATIVE EFFECTS ON SOIL RESOURCES

The cumulative effects analysis area for soil is the MTNF proclamation boundary. This analysis area was chosen because it includes areas proposed for NNIP treatment under alternatives 2 and 3. This area would also include any lands that have yet to be acquired by the Forest Service, but which may need rapid response treatment to reduce NNIP. The temporal boundary is 10 years, because ground disturbance due to NNIP control is expected to be minimal, and would recover within 10 years. Further, the herbicides proposed under alternative 2 would be completely degraded within 10 years.

Past, present and future management activities expected to have effects on soil are considered in the analysis. Management activities such as timber harvests, roads maintenance, and recreation trails impact the soil resource to some degree. However, most of the effects are localized and short-term. The rate at which these projects are implemented is expected to remain at current levels throughout the life of this project.

Past land use has had detrimental impacts to most of the soil resource today. Clear cutting, which began near the turn of the century and continued through the 1920s and 1930s, was followed by farming, annual burning, and grazing. When timber supplies were exhausted, local people turned to farming. Those attempting to pasture the cutover lands had to contend with re-sprouting of hardwoods. Intensive sheep and goat grazing and fire were the primary means of controlling hardwood re-growth and restoring grass cover. Repeated annual fires exposed thin soils to erosion, which robbed hillsides of the nutrients essential for both grass and tree growth (Cunningham and Hauser 1992). Soil erosion continued between 1895 and 1915 as more forests were cleared for road construction (Jacobson and Primm 1997). From the late 1930s to the late 1950s, public land managers became concerned with healing eroding lands, ending annual woods burning, and establishing young forests. However, grazing intensity increased until 1993; causing elevated surface runoff and stream sedimentation (Jacobson and Primm 1997). As a result, many soils on the forest have shallower surface horizons, lower available water holding capacities, and relatively lower soil fertility than during pre-European settlement conditions.

Present and future management activities would be implemented in a manner that minimizes soil impacts. The LRMP standards and guidelines help maintain soil productivity while still allowing the forest to be managed. The proposed physical control methods would be applied to small sites and have relatively low impacts on soils. Thus, because the effects would be negligible, the proposed actions in Alternative 2 would not significantly add to the cumulative effects of past, present, and future actions.

Physical (mowing, disking, hand pulling) and cultural controls (grazing) have been used on non-federal lands to control unwanted plants, but not necessarily to control NNIP. This continues today, and is likely to continue into the foreseeable future. Limited NNIP control, primarily bush hogging, has occurred on non-federal lands to control NNIP interfering with livestock or hay production. It is possible that additional NNIP treatment may occur in the future on non-Federal lands as education and information efforts hit their mark, or as landowners realize the damage being done by NNIP to their livelihood or property values.

Forest Service employees and volunteers have used manual, mechanical, and cultural methods on MTNF lands in the past to control NNIP. The Forest Plan has an objective of controlling a minimum of 2,000 acres of existing infestation over the plan period. The control methods proposed as part of Alternative 2 may result in some short-term and localized effects to soil. However, because the areas treated are relatively small and scattered, treatments would not significantly decrease soil productivity on MTNF lands. There have been no biological controls initiated on MTNF lands in the past.

Chemical: Herbicides have been used extensively in both the past, as well as present, to treat NNIS on non-Federal lands. Many private landowners purchase sprays from local retailers to use them around their homes. Some farmers apply herbicides seasonally to their pastures and hay fields with boom sprayers. Highway departments apply herbicides to roadsides to promote safety and more recently to control NNIP, and utility companies routinely spray corridors to protect underground and surface transmission lines. Herbicides will continue to be used on non-federal lands for these purposes in the foreseeable future and most likely at current levels and intensities. It is possible that herbicides could be used on non-federal lands to treat NNIP to increase pasture areas, but the amount of treatment is expected to be minimal because herbicides treatments can be cost prohibitive to many private landowners.

Herbicides were used on National Forest lands in the 1950s until about 1980 to prepare sites for tree planting, to release young trees to grow, to create semi-open wildlife habitat, and for powerline right-of-way management. Herbicides have been and are currently used to treat poison ivy in campgrounds and recreation areas on the

MTNF, noxious weed control, and some research projects associated with the Sinkin Experimental Forest.

Most of the herbicides proposed under Alternative 2 would quickly degrade in terrestrial systems by natural processes, exhibit low toxicity to a majority of terrestrial and aquatic species, and would not bioaccumulate to significant levels. Known infestations have been mapped and the preferred herbicide has been selected for each infestation. The preferred herbicide will be used as directed on the label to avoid surface runoff. Areas that would be treated by herbicides are relatively small in size and scattered across the Forest landscape. Infestations occurring on soils with high leaching potential would require further mitigations to ensure the herbicide remains on site. Highly permeable soils have been identified, and only herbicides with low soil mobility would be used to treat infestations on those sites. However, treating those sites with the appropriate herbicide would not cause adverse impacts to the soil resource.

WATERSHED

AFFECTED ENVIRONMENT

Watershed Condition is defined by the US Forest Service to be the state of physical and biological characteristics and process within a watershed that affect soil and hydrological functions supporting aquatic ecosystems (US Forest Service 2010b).The analysis area lies within a mix of forested landscape and urbanization (cities, towns, agricultural, and pasture land). A detailed list for all 215 - 6 level hydrologic watersheds, containing physical characteristics, ownership, land use, State designated waters and the beneficial uses, and water quality information is available at: Mark Twain National Forest - Projects. A more detailed report is available in the project record.

Climate: The Ozark region in Missouri is characterized by a temperate climate due to its mid-latitude location in the interior of the North American continent. Yearly average precipitation ranges from 40-50 inches, and precipitation events occur throughout the calendar year. January through May precipitation events increase with April and May having the large amounts of total precipitation. The driest months tend to be November and December. Extreme precipitation events that cause flooding can happen any time of the year but occur most frequently in spring, summer, and fall. On average thunderstorms develop from 10-25 days during each of the seasons, and during the winter is usually fewer than 10 days. Storms can produce intense rain, wind, hail, and cause flash flooding. In the spring and summer tropical cyclones, hurricanes, tropical storms, and tropical depressions are responsible for many of the extreme precipitation events (USDA Forest Service 1999a).

Physiography, Geology, and Hillslope Characteristics: The majority of the Mark Twain National Forest lies within the Ozark Mountain Range, mostly in the Salem Plateau (Ava, Willow Springs, Houston-Rolla, Potosi, Salem, Frederick Town, and Popular Bluff Ranger District) and a small portion of the Springfield Plateau (Cassville Unit) (USDA Forest Service 1999). The Ozark physiographic province is an elongated domal structure extending across Missouri from the Mississippi River to Northern Arkansas to Northeastern Oklahoma (Romito 1984). The maximum elevations range from 1,500 to 1,700 feet with drainage valleys several hundreds of feet deep (Romito 1984), The Salem Plateau contains a central upland area and topography in this upland west of the St. Francois typically consist of gentle rolling hills with local relief from 500 to 100 feet (USDA Forest Service 1999). Away from the central upland area, numerous streams dissect the plateau, resulting in increased relief (USDA Forest Service 1999a). South and east of the upland, topography is rugged with local relief up to 500 feet. North of the central upland, topography is also rugged, but relief rarely exceeds 300 feet (USDA Forest Service 1999a).

The Salem, Potosi, and Frederick Town Ranger Districts have sections that are within the St. Francois Mountains that are formed from exposure of igneous rocks of Pre-Cambiran age (Romito 1984). There are three types of igneous rocks: ryolites and andesites of volcanic origin, granites and granite porphyries and basic intrusive of gabbroic composition (Romito 1984). The St. Francois Mountains are a series of resistant hills or knobs separated by valleys that are underlain by sedimentary rocks of Cambrian age. Altitudes of land surfaces range from 1,000 to 1,700 feet above sea level. Topography is rugged with relief ranging from 500 to 800 feet. The unique geological features affect the hydrology of the area, compared to the surrounding karst topography of the Salem Plateau (USDA Forest Service 1999a).

The Cedar Creek Unit (Houston/Rolla/Cedar Creek Ranger District) is the only unit located north of the Missouri River. This unit is located within the dissected till plans created by glaciers (Romito 1984).

Surface and Subsurface Hydrology and Water Quality: The Salem and Springfield Plateau landscape is characterized as karst topography. Karst landscapes are characterized by the presence of caves, springs, sinkholes, and losing streams, created as groundwater dissolves soluble rock such as limestone or dolomite. In karst terrain there is a strong interaction between surface water and ground water. Sinkholes and losing streams are sources of input into the groundwater and springs, seeps, and caves are outputs to the surface water. In the Ozarks the rock formations consist of alternating layers of dolomite or limestone and sandstone. Sinkholes and springs are abundant in the Salem Plateau. The upland area has an average of 1-10 sinkholes per 100 square miles. Springs generally have discharges exceeding 100 cubic feet per second (USDA Forest Service 1999).

In the State of Missouri, there are three types of public water systems (Missouri Department of Natural Resources 2008):

- Community systems - Include towns, water districts, subdivisions, mobile home parks and residential facilities such as nursing homes or prisons.
- Nontransient non-community systems - Serve the same people every day, but not in a residential setting; schools and factories are good examples.
- Transient non-community systems - Serve different people daily, such as restaurants, resorts and rest stops. These smaller systems are typically in rural areas where it is not feasible to hook up to a city or water district.

In 2008 the largest source of drinking water for Missourians is surface water from the Missouri River and groundwater is the next most used source of drinking water for Missouri's community supplies (Missouri Department of Natural Resources 2008).

The conclusion of the vulnerability assessment determined Missouri public drinking water wells are not vulnerable to sources of contamination, and are on a 6- year testing schedule (personnel communications with Todd Eichholz, Missouri Department of Natural Resources, and Public Drinking Water Branch)

The most current public drinking water report available is the Missouri Department of Natural Resources 2008 Annual Compliance Report of Missouri Public Drinking Water Systems. The report including water quality information on the following herbicides proposed for use in this project: 2, 4-D, endothall, and glyphosate. There were no findings of these 3 chemicals above the EPA maximum contaminate level (MCL) for drinking water (Missouri Department of Natural Resources 2008). Dicamba is not included in the report.

United States Geological Survey (USGS) in 1991 started the National Water Quality Assessment (NAWQA) Program. The initial, high intensity phase of the Ozark Plateaus NAWQA began in 1991 and continued through 1995 and personnel collected ground water, surface-water, and biological samples (USGS 1998a). The NAWQA database was queried for surface water and groundwater sampling of all proposed chemicals within all HUC-4 watersheds south of the Missouri River and the HUC-4 that contains the Cedar Creek Ranger District (results available in the project record). Chemicals in the database include 2, 4-D, 4 Dichlorophenol (a chlorinated derivative of phenol with the molecular and is used primarily as intermediate in the preparation of the herbicide 2, 4-D), Clopyralid, Dicamba, and Triclopyr. All detections 2, 4-D and 2, 4 Dichlorophenol were well below drinking water standards. When 2, 4-D was detectable the maximum concentration was 0.00012 mg/L and for and 2, 4 Dichlorophenol the maximum concentration was 0.0005 mg/L. All de(including prescribed fire) detections of Dicamba were well below Missouri Department of Natural Resources (MoDNR) Health Advisory Levels, with a maximum concentration of 0.000069 mg/L. Clopyralid and Triclopyr were found in surface water and groundwater, however these chemicals do not have an EPA MCL or Missouri Health Advisory Level. For environmental effects of these chemicals, refer to the “Environmental Consequences” section.

Major findings of the NAWQA study are summarized below (USGS 1998a):

- In streams and ground water, pesticides were more prevalent in agricultural areas than in forested areas. Concentrations generally were low and seldom exceeded U.S. Environmental Protection Agency (EPA) drinking-water criteria or standards, or criteria for the protection of aquatic life.
- In bed sediment, the greatest numbers of pesticides and other organic compounds generally were detected at sites downstream from urban areas. No concentrations exceeded U.S. Environmental Protection Agency criteria for the protection of aquatic life.
- In biological tissue, pesticides were detected at 5 of 26 stream sites. Chlordane was detected downstream from Springfield, Mo. DDT, DDE, or dieldrin was detected at four sites in agricultural basins.

The existence of aminopyralid, fluroxypyr, fossamine ammonium salt, imazapry, and sethoxydim are unknown. These chemicals were not included in either report mentioned above. However, it is expected that these chemicals would have an increased concentration in agricultural areas compared to forested areas, based on the prevalence of chemicals from the NAWQA findings.

DIRECT AND INDIRECT EFFECTS ON WATERSHEDS

- Watershed Condition is defined by the US Forest Service to be the state of physical and biological characteristics and process within a watershed that affect soil and hydrological functions supporting aquatic ecosystems (US Forest Service 2010b). For compliance with Federal and State Laws the following categories are considered in the assessment for watershed condition: State designated waters and the beneficial uses, and water quality information is available at: Mark Twain National Forest - Projects
- Category 1 (All Surface and Drinking Water) - Water of the State, Outstanding National and State Resource Waters, and Defined Beneficial Uses (Including Safe Surface and Ground Drinking Water) as defined by the Missouri Code of State Regulations.
- Category 2 (Impaired Waters) - 303(d) Impaired Waters as defined by the Missouri Code of State Regulations: The Clean Water Act requires the identification of water bodies that do not meet, or are not expected to meet, water quality standards or are considered impaired. The 2010 list used in this analysis has been approved by EPA. Category 3 (Karst Geological Resource) –For purpose of this report karst geological resources include caves, fens, sinkholes, springs, losing streams, and groundwater dependent ecosystems. The Mark Twain National Forest, Federal Laws, and Missouri State Laws protect karst geological resources and associated ground water dependent ecosystems.

Timeframe: The proposed management treatments of manual, mechanical, cultural, chemical and biological have the potential for multiple effects with different time frames:

- Removal of effective ground cover: 1 year – Effective ground covers includes vegetative litter and duff, fine and large woody debris, rock greater than ¾-inch thick, and live vegetation. Non-point source pollution from soil erosion is the most likely adverse effect as a result of ground disturbing activities that cause the removal of vegetative soil cover. Effective ground cover serves several purposes in the mitigation of accelerated soil erosion by dissipating the energy of falling raindrops through interception. Without effective ground cover, an intense storm can generate large quantities of sediment from hillslopes. The effective ground cover absorbs water, increases storage capacity, and slows the velocity of overland flow (Poff 1996). Based on observations during monitoring trips, typically effective ground cover returns within one year or less, and erosional process return to normal function. However, the response of landscapes to land disturbances is influenced by climate, topography, geology, and ecology (USDA 2005b). In most cases the disturbance caused by past land management activities diminishes through time.

- Herbicides: A few days to 2 years – dependent on the half-life of the chemical, varies from a few days to 2 years. The greatest concern for effects to Categories 1-3 is meeting general and specific criteria outlined in the Missouri Code of State Regulations (CSR), Rules of Department of Natural Resources Title 10, Division 20, Chapter 7 Section 31: Water Quality Standards (10 CSR 20-7.031).

Spatial boundary: Mark Twain National Forest Lands

Methodology:

Direct effects on watershed condition result when Mark Twain National Forest Service land management activities result in deposition of sediment or pollutants directly into a stream course, reservoir, lake, pond, floodplain, cave, spring, fen, sinkhole, or riparian vegetation area. Increased erosion, sedimentation, and pollutants directly into these areas may result from some of the following examples: proposed mechanical activities such as disking and herbicide application directly into a stream, pond, or lake to remove invasive plants in the aquatic environment or through unintended spray drift.

Indirect effects can occur on watershed condition when hillslope destabilization and/or detachment and mobilization of sediment or pollutants will eventually reach streams. Examples include proposed mechanical activities such as disking, grazing, and herbicide treatments. Indirect effects are also naturally occurring in areas that are steep or after wildland fires. Increased erosion and sedimentation may result in increased peak channel flows, alteration of annual flow distribution, stream channel geometry alteration, and degradation or aggradation of channel beds. Degradation is the lowering of a fluvial surface, such as a streambed or floodplain and aggradation occurs in areas in which the supply of sediment is greater than the amount of material that the stream system is able to transport. Indirect effects from herbicide application include the mobilization of chemicals offsite from intended target location. Offsite movement of an herbicide is based on solubility in water (the higher the solubility value, the greater the likelihood for movement), soil organic sorption coefficient (values less than 500 tend to move with water than adsorbed to sediment), and half-life (the longer the half-life, the greater the potential for movement).

Direct and indirect effects are determined by using available monitoring data, scientific research, and the WIN-PST model developed by the Natural Resource Conservation Service (NRCS). The WIN-PST model rates the loss potential of a specific herbicide when applied to a specific soil. Soil physical and chemical characteristics, such as texture, organic matter content, and surface horizon depth are considered in the ratings. WIN-PST computes the leaching potential, solution runoff potential, and the adsorbed runoff potential for both the soil and the given herbicide. Those outputs are then combined to develop soil-herbicide interaction loss potentials. Herbicide and soil loss potentials are described in detail in the EIS, Appendix D. Project design criteria (also known as Best Management Practices or mitigation measures) were developed to reduce effects.

ALTERNATIVE 1 – NO ACTION

No changes would occur to the physical and chemical components of defined beneficial uses. No chemicals would be added to the environment, and the risk of adverse effects to the drinking water supply, irrigation, recreation uses, and aquatic habitat would not occur.

No changes would occur on waters on the 303(d) list (impaired waters).

No proposed activities would occur and, as a result, no adverse effects would occur to karst geological resources and the associated sensitive ground water dependent ecosystems.

However, the purpose and need of this project would not be met. The threat of invasive plants would continue to increase and beneficial uses identified for aquatic habitat would continue to decline. The lack of controlling non-native invasive plants could adversely affect the following beneficial uses: cold-water, cool-water, and warm-water fisheries and habitat for resident and migratory wildlife species. The native plants within these habitats could be lost, altering the chemical, physical, and biological components of these habitats.

ALTERNATIVE 2 – PROPOSED ACTION

The MTNF proposes to implement an integrated program for the prevention, eradication, suppression, and reduction of existing and future NNIP infestations on National Forest System lands within the Mark Twain National Forest. Control methods include various combinations of manual, mechanical, chemical, cultural, and biological treatments. Treatments are described in detail in Chapter 2 and Appendix C.

Manual: There are no adverse direct and indirect effects as result of this treatment method to watershed condition. Manual treatments include pulling, grubbing, hand cutting, and digging with hand tools. These treatments cause very minimal, localized ground disturbance and have no potential for removal of effective ground cover.

Mechanical Treatments

Cut: The cut method includes the following: cut/clip with lopping shears, saw, brush cutter, weed whip, mower, or similar equipment. This action can be used alone or followed by sponge-application or hand-spraying of systemic herbicide.

Depending on the species and density or the infestation, this type of activity may cause a short-term increase in exposed bare soil if both herbaceous cover and canopy have been lost to canopy cover. This generally occurs with dense stands of invasive woody shrubs, such as kudzu, tree of heaven or honeysuckles. Effective ground cover does not exist under the thick canopy of these invasive plants. However, these types of activities generally do not cause increased runoff during overland flow and increased sedimentation into the stream network when an effective ground cover exists in the riparian corridor. With the adherence of Forest Plan standards and guidelines, effective ground cover loss would be within a small area and overall effective ground cover would remain. If any sediment reaches the stream network it would be minimal, short-term, and within the range of natural variability, therefore there are no anticipated adverse direct and indirect effects to the watershed condition.

Disc: The disc method includes the following: use of tractor-mounted disc, hand tiller, or similar equipment. This method is used to develop a perimeter around an infestation to keep it from spreading outward and can be incorporated with planting of native vegetation as a means of competitive control.

This type of activity exposes bare soil and can cause increased soil erosion, due to the loss of effective ground cover. With the adherence of Forest Plan standards and guides, effects are expected to be short-term and within the natural range of variability. Therefore, there are no anticipated adverse direct, indirect, or cumulative effects to watershed condition as a result of the disc treatment method.

If disk method occurs in areas of soil contamination from windblown deposits from lead and zinc smelter operations, the effects are unknown. However, if additional contaminated soil does impact the watershed condition, it is expected to be immeasurable and not cause the additional listing of impaired water on the 303(d) list.

Girdle: The Girdle method includes cutting away a strip of bark several centimeters wide around the entire stem circumference. The removed strip must be cut deep enough into the trunk to remove the vascular cambium, or inner bark. The cuts can be made using a knife, ax, saw, “ringer,” or similar tool and should be slightly deeper than the cambium. This action can be used alone or followed by sponge-application or hand-spraying of systemic herbicide.

This type of activity creates dead standing trees that eventually become large woody debris and increases effective ground cover. Large woody debris is beneficial to soil productivity, soil nutrient cycling, and stream aquatic habitat. There are no adverse direct and indirect effects to the watershed condition, and therefore no cumulative effects, as result of this treatment method.

Cultural Treatments

Competition: The competition method involves planting native perennials (typically warm-season grasses) on treated infestations. This method does not create a loss of effective ground cover or increased sedimentation. There are no adverse direct and indirect effects to beneficial uses, impaired waters, and karst geological resources as result of this treatment method.

Grazing: This method involves the use of ungulates such as cows, goats, and sheep to control certain NNIP. By itself, grazing will rarely completely eradicate invasive plants. However, when grazing treatments are combined with other control techniques, such as herbicides or biocontrol, severe infestations can be reduced and small infestations may be eliminated. Depending on the quantity and concentration of mammals and the soil type, grazing can cause direct and indirect effects to watershed condition. Forest Plan Standards and Guides include best management practices to minimize direct and indirect effects including no grazing within 100 feet of stream banks within protected riparian management zones (RMZs). Grazing proposed solely for NNIP control would most like be only a few animals confined to a small area and moved frequently. In this case, there would be negligible, short term effects to watershed conditions.

Scorch: This method includes the use of the flame from a propane weed torch to scorch or wilt green leaves. This is done either very early or late in the growing season when exotics are green and native perennials are mostly below ground. It does not start a ground fire. Scorching will kill one year's growth of annual and biennial weeds.

This method does not create a loss of effective ground cover or increased sedimentation to stream network. There are no adverse direct and indirect effects as result of this treatment method to watershed condition.

Smothering: Smothering small infestations with mulch (hay, grass clippings, wood chips, etc.) or other type of ground cover (newspaper clippings, plastic sheeting). This prevents weed seeds and seedlings from receiving sunlight necessary to survive and grow.

This method does not create a loss of effective ground cover or increased sedimentation to stream network. There are no adverse direct and indirect effects as result of this treatment method to watershed condition.

Waipuna® Hot Foam: This method is comprised primarily of a diesel-powered boiler and foam generator, which deliver hot water with a foam surfactant to target weeds via a supply hose and a treatment wand. This Organic Foam solution uses natural plant sugar extract from corn and coconut. The superheated hot foam is applied to the targeted vegetation at a precise temperature (93 degrees C, 200 degrees F) and pressure; the foam traps the steam, giving it time to "cook" or "blanch" the vegetation. This causes a cellular collapse of the treated aboveground vegetation. This control method is limited in mobility and is best used near developed sites such as work centers, campgrounds, trailheads, and along some roadsides.

Since the foam is a natural plant sugar extract it does not affect water quality. As a result, this treatment method does not cause an adverse direct and indirect effect to watershed condition.

Direct and Indirect Chemical Treatment Methods:

RESPONSE TO ISSUE A

As discussed in the Soil Section, Herbicides can move off-site contaminating surface and groundwater and possibly causing adverse impacts to watershed condition. An herbicide loss is assumed to have occurred if the herbicide is leached below the root zone, or leaves the treatment area in solution or adsorbed on sediment suspended in runoff waters. The potential of losing herbicides from a field by surface water runoff or leaching below the root zone is a combined function of herbicide, soil, climate, and management factors (Wauchope 1990). Also, the potential for a specific herbicide to move off site is based on the herbicides solubility, its affinity to sorb to organic carbons and the herbicides half –life.

The following table displays the proposed herbicides and properties that influence mobility.

Table 8 Herbicide Solubility, Sorption, and Half-Life

Active Ingredient (Common Name)	Solubility in Water (ppm)	Koc – Soil organic sorption coefficient (mL/g)	Half-Life (days)
2,4-D	890	20	10
Aminopyralid	212	1,000	26
Clopyralid	1,000	2	30
Dicamba	4,500	5	14
Endothall	100,000	124	7
Fluroxypyr	136,000	200	36.3
Fosamine ammonium	1,790,000	150	8
Glyphosate	12,000	3,500	47
Imazapyr	11,000	100	90
Sethoxydim	4,390	100	5
Triclopyr	435	27	155

Source (WIN-PST 3.1)

Solubility (SOL) - Solubility is the measure of an active ingredient's ability to dissolve in water at room temperature. It is expressed in mg/L (ppm). Solubility is a fundamental physical property of a chemical and affects the ease of wash off and leaching through soil. In general, the higher the solubility value, the greater the likelihood for movement.

Koc - Soil organic carbon sorption coefficient of an active ingredient in mL/g. Koc measures the affinity for herbicides to sorb to organic carbon. The higher the Koc value, the stronger the tendency to attach to and move with soil. Soil pH can affect the Koc of ionic and partially ionic herbicides. An herbicide with an anion as the active species would have a Koc set low to account for that herbicide's inability to sorb to soil particles. A cationic active species would tend to bind strongly with soil and therefore have a relatively high Koc. Herbicide Koc values greater than 1,000 indicate strong adsorption to soil. Herbicides with lower Koc values (less than 500) tend to move more with water than adsorbed to sediment.

Half-Life (HL) - Half-life of an active ingredient under field conditions, in days. Sometimes referred to as field dissipation half-life. Half-life is the time required for an herbicide to degrade to one-half of its previous concentration. Each successive elapsed half-life will decrease the herbicide concentration by half. For example, a period of two half-lives will reduce an herbicide concentration to one-fourth of the initial amount. Half-life can vary by a factor of three or more from reported values depending on soil moisture, soil pH, temperature, oxygen status, soil microbial population, and other factors. Additionally, resistance to degradation can change as the initial concentration of a chemical decreases. It may take longer to decrease the last one-fourth of a chemical to one-eighth than it took to decrease the initial concentration to one-half. In general, the potential for herbicide movement increases with the length of its half-life.

The solubility, sorption, and half life of herbicides are used in the WIN-PST model to assign herbicides loss potentials.

Herbicide Leaching Potential (PLP): Indicates the tendency of an herbicide to move in solution with water and leach below the root zone.

Herbicide Solution Runoff Potential (PSRP): Indicates the tendency of an herbicide to move in surface runoff in the solution phase.

Herbicide Adsorbed Runoff Potential (PARP): Indicates the tendency of an herbicide to move in surface runoff attached to soil particles.

Table 9 WIN-PST Herbicide Active Ingredient Ratings

Active Ingredient (Common Name)	SPISP II Herbicide Rating			Exposure Adjusted Toxicity Category		
	PLP Spot [Broadcast]	PSRP Spot [Broadcast]	PARP Spot [Broadcast]	Human (Water)	Fish (Water)	Fish (Sediment)
2,4-D	V (fp) [L (f)]	L (fp) [L (f)]	L (fp) [L (f)]	L	V	V
Aminopyralid	V (fpl) [V (fl)]	L (fpl) [L (fl)]	L (fpl) [L (fl)]	V	V	V
Clopyralid	L (fp) [I (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	V	V
Dicamba	L (fp) [I (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	L	V
Endothall	V (fp) [V (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	L	V
Fluroxypyr	V (fp) [V (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	V	V
Fosamine ammonium	V (fp) [L (f)]	L (fp) [L (f)]	L (fp) [L (f)]	L	V	V
Glyphosate	V (fp) [V (f)]	L (fp) [I (f)]	L (fp) [I (f)]	V	V	V
Imazapyr	L (fp) [I (f)]	L (fp) [I (f)]	L (fp) [I (f)]	V	V	V
Sethoxydim	V (fp) [V (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	L	V

Active Ingredient (Common Name)	SPISP II Herbicide Rating			Exposure Adjusted Toxicity Category		
	PLP Spot [Broadcast]	PSRP Spot [Broadcast]	PARP Spot [Broadcast]	Human (Water)	Fish (Water)	Fish (Sediment)
Triclopyr	L (fp) [I (f)]	L (fp) [I (f)]	L (fp) [I (f)]	V	V	V

Legend

I -- Intermediate

L -- Low

V -- Very low

p -- Spot application; applied to 1/10 of the field or less

f -- Foliar application; directed spray at nearly full weed canopy

l -- Low rate of application; 1/10 to 1/4 lb/acre

The herbicides evaluated for Alternative 2 indicated a very low to intermediate loss potential for foliar spot and broadcast application with standard application rates under a high rainfall climate. All spot applications were rated low to very low. No method rated high or very high. It is unlikely that chemicals applied to control NNIP would move offsite.

PLP, PSRP, and PARP herbicide ratings in the above table are combined with SLP, SSRP and SARP soil ratings in a Soil/Herbicide Interaction Matrix that results in ILP, ISRP, and IARP Soil/Herbicide Interaction ratings.

Soil Leaching Potential (SLP): The sensitivity of a given soil to herbicide leaching below the root-zone. Characterizes those soil properties that would increase or decrease the tendency of an herbicide to move in solution with water and leach below the root zone. A high rating indicates the greatest potential for leaching.

Soil Solution Runoff Potential (SSRP): The sensitivity of a given soil to herbicide loss dissolved in surface runoff that leaves the edge of the field. A high rating indicates the greatest potential for solution surface loss.

Soil Adsorbed Runoff Potential (SARP): Represents sensitivity of a soil to herbicide loss adsorbed to sediment and organic matter that leaves the edge of the field. SARP characterizes those soil properties that would increase or decrease the tendency of an herbicide to move in surface runoff attached to soil particles. A high rating indicates the greatest potential for sediment/herbicide transport. These interaction ratings provide a relative potential for herbicide loss for each soil/herbicide combination. ILP ratings indicate the potential for herbicides to leach below the root zone. ISRP ratings indicate the potential for herbicides to move beyond the edge of the field dissolved in solution runoff. IARP ratings indicate the potential for herbicides to move beyond the edge of the field adsorbed to sediment and organic matter that is suspended in runoff water.

The matrixes for soil/herbicide interactions can be found in Appendix D.

WIN-PST3 reports for this project's herbicides and soils are available at: Mark Twain National Forest - Projects. The WIN-PST3 reports have been summarized by watershed. The summary includes the SLP, SSRP, and SARP ratings soil map units by acres and percentage of acres within each HUC-6 watershed. The soil map units may or may not include Mark Twain National Forest Lands. Most watersheds contain soil map units with a high SLP (soil leaching potential).

The reports are generated by Forest Service unit and are several hundred pages and cannot be easily summarized and displayed in this document and are therefore incorporated by reference. These reports are used to assist in the planning of herbicide applications for specific soil map units with NNIP infestation were herbicides will be used.

Based on the information presented additional design criteria have been developed to minimize the potential for adverse direct and indirect effects to Watershed Condition:

- The use of highly mobile herbicides shall be avoided on soils with highly leachable properties where the Soil – Herbicide Interaction, Leaching, Solution Runoff, and Adsorbed Runoff Potential is rated high or extra high. For soils with an intermediate rating, a field visit by the Forest Soil Scientist must be made prior to application.
- No herbicides will be used within any fen (the fen proper) or connected drainage feature known to be occupied by Hine's emerald dragonfly larvae or adults unless a "wicking method" is approved by FWS and FS hydrologist.
- Unless approved by the USFWS and Forest Service hydrologist, no endothall or triclopyr will be used within fens known to contain Hine's emerald dragonfly larvae or adults or the fen buffer area. The fen buffer area is defined in the Forest Plan (p 2-13) as 0.5 mile upstream of the fen and 300 feet on the lateral sides of perennial streams that may feed into that fen within 0.5 miles upstream.
- No application of herbicides will occur in the Tumbling Creek cavesnail recharge area within 72 hours prior to expected precipitation.
- Aquatic herbicides will only be applied to man-made impounded waters, i.e. lakes and ponds.

The goal of the above design criteria was minimize adverse direct and indirect effects to RMZs, WPZs, fens, caves, springs, and sinkholes and protect karst terrain. Product label restrictions minimize the potential direct effect to ephemeral stream channels and associated aquatic habitat. Site specific situations where adverse localized direct and indirect effects might occur include:

- An ephemeral channel surface and subsurface hydrologically connection to fen recharge outside of the protected fen designation
- A forest road with ephemeral stream crossings, where the ditch is hydrologically connected to an ephemeral stream. This situation is very common, and length of hydrological connection is variable.

Potential adverse direct and indirect effects to the Watershed Condition are not quantifiable but are expected to occur only in the vicinity of the herbicide application. Duration of the adverse effect is dependent on the concentration and half-life of the herbicide and timing of a precipitation event post application.

Direct and Indirect effects of Biological Control Treatments

Biological control treatments involve releasing specific insects or other organisms that feed on or parasitize specific plant species. The insects are typically native to Europe, Asia, or other parts of the world where the target plant occurs naturally, and have been approved for release in the United States by the United States Department of Agriculture (USDA). Biological control of plants is already a common practice for some NNIP in Missouri. The proposed action includes the following biological control treatments: root weevil, seed head weevils, a rust fungus, black-dot leafy spurge flea beetle, brown-legged leafy spurge flea beetle, copper leafy spurge beetle, flower head weevil, milfoil weevil, and rosette weevil.

There are no direct and indirect effects to the watershed condition. Biological control treatments target specific plants, and not all vegetative would be consumed. Loss of effective ground cover would not occur; therefore, there are no direct, indirect, and cumulative impacts

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

Manual Treatments:

Direct, Indirect, and Cumulative Effects – Same as Alternative 2 – Proposed Action

Mechanical Treatments:

Direct, Indirect, and Cumulative Effects – Same as Alternative 2 – Proposed Action

Cultural Treatments:

Direct, Indirect, and Cumulative Effects – Same as Alternative 2 – Proposed Action

Chemical Treatments:

Direct, Indirect, and Cumulative Effects – Same as Alternative 1 – No Action

Biological Control Treatments:

Direct, Indirect, and Cumulative Effects – Same as Alternative 1 – No Action

CUMULATIVE EFFECTS

Timeframe: Cumulative effects are the measurement of past, present, and reasonable foreseeable future actions. The response of landscapes to land disturbances is influenced by climate, physiographic, geologic, and ecologic conditions. In most cases the disturbance caused by past land management activities diminishes through time.

- Removal of effective ground cover: 3 years
- Herbicides: The effect of herbicide application is not expected to diminish through time on a watershed scale. Application of herbicides is a common use on agriculture lands (crops and pasture), weed control in yards, and used on

public state and local lands for various purposes. On the Mark Twain National Forest, herbicide use will continue through the duration of this Plan or until non-native invasive plants are eliminated and natural communities are restored.

Spatial boundary: The scope of the cumulative effects analysis includes HUC-6 watersheds (Hydrologic Unit Code, 12 digits) because they include all the areas potentially impacted by the proposed actions.

Methodology:

- Removals of effective ground cover - Cumulative effects are determined by using best available monitoring data and scientific research to determine if effects would be adverse, indifferent, or beneficial. On the Ouachita National Forest in Arkansas, sediment is used to measure cumulative effects from land management activities and studies indicate increased sediment as a result of timber harvests are identifiable for up to 3 years (Clingenpeel and Crump 2005). If effects were determined to be adverse, then project design mitigations (BMPs) were developed to reduce effects.
- Chemical treatment methods - Cumulative effects are determined by using the conclusions from the latest USGS NAWQA study, which is considered the best available science. Watersheds with higher agriculture use have a higher risk for adverse effects to beneficial uses compared to watersheds with a higher percentage of a forested landscape (see the “Existing Condition” and “Environmental Consequences” section for more information). If effects were determined to be adverse, then project design mitigations (BMPs) were developed in to reduce effects if it meets the purpose and need of the action alternative.

Manual: There are no direct or indirect effects; therefore, there are no cumulative effects from manual treatments.

Mechanical

Girdle - There are no direct or indirect effects from girdle treatment methods, therefore there are no cumulative effects.

Cut and Disc - As discussed under the existing condition sediment in streams is adversely affecting watershed condition, and the largest amount of sediment comes from roads. The additive cumulative effects from sedimentation as a result of cut and disc treatment methods are expected to be short-term and immeasurable with the application of Forest Plan standards and guides.

In HUC-6 watersheds, the additive adverse cumulative effects are unknown as the result of the disk method in areas of heavy metal soil contamination from lead and zinc mining activities. However, the cumulative effects are expected to be minimized with development of the project design criteria used to minimize direct and indirect effects, minimal compared to the “point source” and not cause the additional listing of an impaired water.

Cultural: There are no direct or indirect effects from competition, grazing, scorch, smothering, and Waipuna® Hot Foam treatments; therefore, there are no cumulative effects.

Chemical: The existing concentrations of each proposed herbicide within each HUC-6 watershed is unknown. As mentioned under the existing condition, Missouri Department of Natural Resources monitors herbicide concentrations with an EPA MCL or DNR health drinking advisory in both surface water and groundwater municipal drinking water systems. None of the proposed herbicides exceeds the EPA MCL or DNR health drinking advisory. Additionally the USGS NAWQA program tested herbicides in both surface water and groundwater. Some of the proposed chemicals under Alternative 2 were included in the study and none exceeds EPA drinking-water criteria or standards, or criteria for the protection of aquatic life. The NAWQA study had the following conclusions:

- In streams and ground water, herbicides were more prevalent in agricultural areas than in forested areas. Concentrations generally were low and seldom exceeded U.S. Environmental Protection Agency (EPA) drinking-water criteria or standards, or criteria for the protection of aquatic life.
- In bed sediment, the greatest numbers of herbicides and other organic compounds generally were detected at sites downstream from urban areas. No concentrations exceeded U.S. Environmental Protection Agency criteria for the protection of aquatic life.

Based on the, NAWAQ study the following assumptions have been made:

> Landscapes with a high agriculture use (50% or greater) are at a higher risk for adverse cumulative effects due to the application rates on agriculture lands and forested landscapes (50% or greater) have a lower risk potential for adverse cumulative effects

The project record includes information on each HUC-6 watershed in the watershed condition analysis area, landscape use, and potential risk of adverse cumulative effects of from the use of proposed chemical treatments. Watersheds with a higher percentage of forested landscape have a rating of lower risk potential for cumulative effects. Watersheds with a higher percentage of cropland and pasture land have a rating of greater risk potential.

Table 10 includes a summary of watershed with a greater risk potential for cumulative effects. Only nine percent of the watersheds in the analysis area have a higher risk potential of adverse cumulative effects to Category 1- All Surface and Drinking Water and Category 3 - Karst Geologic Resources. In these watersheds, Mark Twain National Forest Ownership is 10% or less.

Table 10: HUC-6 Watersheds within the Analysis Area with a Greatest Risk Potential for Cumulative Effects from Herbicide Treatments

Ranger District	Total HUC-6 Watersheds within the Analysis Area	Total HUC-6 Watersheds with a Higher Agriculture Use
Cedar Creek	4	4

Ranger District	Total HUC-6 Watersheds within the Analysis Area	Total HUC-6 Watersheds with a Higher Agriculture Use
Houston-Rolla	31	2
Salem and Potosi	43	0
Frederick Town	22	2
Cassville	18	3
Ava	25	1
Willow Springs	17	3
Eleven Point	34	1
Popular Bluff	21	3
Total	215	19

The proposed chemicals have never been detected above drinking water MCL and criteria for protection of aquatic life. Therefore, even though there is a potential for localized adverse indirect effects to Watershed Condition, long-term adverse cumulative effects are not anticipated from the proposed herbicide use on Mark Twain National Forest Lands. If chemical treatment methods are controlled through implementation of Forest Plan standards and guides and BMPs, the potential for project related chemical delivery to the immediate channel and channels downstream would be small. The Forest Plan standards and guides and BMPs provide for more protection beyond the product label requirements. Adverse impacts to Watershed Condition could potentially occur under the following circumstances:

1. Failure to implement Best Management Practices, Forest Plan Standards and Guidelines, and other required project developed mitigations;
2. Extreme water yields resulting from abnormally high intensity, magnitude, and duration storm events (discussed under the "Existing Condition" section) before the herbicide breaks down to its half-life; and

Even if one or all of the above occurs, it is not expected that the proposed use herbicides would create long-term adverse cumulative effects to Watershed Condition.

There are no listed impaired waters on the 303(d) list from the proposed herbicides. Based on the information provided in the analysis for direct, indirect, and cumulative effects, the proposed use of herbicides in not expected to cause a new impaired waters listing with the effective implementation of Forest Plan Standards and Guides and the application of project design criteria.

Biological: There are no direct and indirect effects; therefore, there are no cumulative effects from biological treatments.

WILDLIFE RESOURCES AND MIS

AFFECTED ENVIRONMENT

The approximately 1.5 million acres of MTNF and the specific project areas are located within the Central Hardwoods region, and are comprised primarily of mixed oak and mixed oak-pine forest communities. The MTNF is drained by several streams and is within one of the nation's largest karst terrains. Past biological surveys have identified hundreds of aquatic and terrestrial animal species present on or near the MTNF during all or part of their life cycle (i.e., 62 mammals, 299 birds, 68 reptiles, 50 amphibians, 200 fishes, 25 crayfish, 14 freshwater mussels, and countless invertebrates and plants (Missouri Fish and Wildlife Information System, accessed 04/26/11).

Because the MTNF lies in the transition between the western prairies and eastern deciduous forests, it supports a great diversity of wildlife. Some species are common; others are relatively rare and/or exist on the edge of their ranges. Many warblers and other migratory songbirds breed on the Mark Twain National Forest, including cerulean and Swainson's warblers. Common browsers include white-tailed deer and cottontail rabbit. Other mammals include the short-tailed shrew, groundhog, gray and fox squirrels, southern flying squirrel, gray and red fox, raccoon, skunk, spotted skunk and opossum. Common reptile/amphibian species include the rough green snake, water snakes, kingsnakes, eastern hognose snake, copperhead, fence lizard, five-lined skink, three-toed box turtle, snapping turtle, northern spring peeper, leopard frog, long-tailed salamander, western slimy salamander, cave salamander, garter and ribbon snakes. Eastern-collared lizards are found on western and southern Missouri glades. Black bear, bobcat and wild turkey are also found on the forest.

All forest successional stages on the MTNF are important as habitat for wildlife species. Early successional habitats support blue-winged warblers, chats, prairie warblers, deer, turkey and northern bobwhite. More mature forest/woodlands support species such as woodpeckers, broad-winged hawk, and flying squirrels. Wildlife such as beaver, mink, otter, and muskrat frequent the edge of lakes and streams. Lake and stream edges also provide food and cover for a wide variety of songbirds, predators, waterfowl, shorebirds, and amphibians. Specialized habitats such as glades, fens, caves, cliffs, snags, cavity trees, and downed woody debris also provide important habitat for unique species such as collared lizards, Tumbling Creek cavesnail, Hine's emerald dragonfly, timber rattlesnakes, and Indiana bats.

The lakes and streams of the MTNF provide a variety of fish including smallmouth and largemouth bass, catfish, walleye, rainbow trout, and panfish. In addition, several species of mussels and crayfish find homes in MTNF waters, some of which are endemic and others of which are federal and/or state TES. Streams of the Ozarks also harbor the unique and state endangered Eastern and Ozark hellbenders, a large aquatic amphibian.

The Mark Twain National Forest contains over 600 known cave entrances, and thousands of other karst features such as losing streams, sinkholes, springs, and estavalles. Groundwater recharge is both discrete and diffuse. Water can travel from the surface to underground aquifers very quickly and with little time for particles to adhere to soil or to breakdown through natural processes. Some of the cave species are confined to one or a few caves and many species are quite susceptible to even small changes in their physical environment.

Management Direction: The 2005 MTNF Forest Plan directs that desired ecosystems throughout the forest be maintained "with few occurrences of non-native invasive species" and "control or reduce existing occurrences of non-native invasive species." (USDA Forest Service 2005a, page 1-2). Further, Goal 1.4 for Wildlife and Aquatic Habitat directs that natural communities will be restored and maintained "as the primary means of providing quality terrestrial, karst, and aquatic wildlife and rare plant habitat." (USDA Forest Service 2005a, page 1-3). Additional direction for controlling NNIP for wildlife benefits can be found on page 2-8 under TES, Hine's emerald dragonfly: "Control non-native invasive and/or undesirable plant species in fen habitats through the most effective means while protecting water quality."

In addition, direction for NNIP in Management Prescriptions 1.1 and 1.2 emphasizing restoration of natural communities on the Forest states: "Remove, control, or contain occurrences of non-native invasive species in existing native prairies upon discovery and in other natural communities as feasible." (USDA Forest Service 2005a, pages 3-4 and 3-8).

During analysis for the 2005 Forest Plan, Non-native invasive species were identified as one of three biological threats (USDA Forest Service 2005, page 3-72) which "seriously threaten forest health in many places."

In the species viability analysis (SVE) analysis for the Forest Plan, habitat loss is indicated as a threat to all 66 animal species evaluated, while water quantity & quality problems are identified as threats to 38 species (USDA Forest Service 2005, page 3-133). Based on addressing the identified threats, Species Viability Analysis also identified Conservation Approaches for Species at Risk (SAR). Conservation Approach J is to "Control non-native invasive species" (USDA Forest Service 2005, page 3-131). This Conservation Approach was identified as benefiting 39 of the 76 animal species and habitats evaluated.

Forest Plan standards and guidelines were developed to limit impacts of NNIP treatment (and other forest management activities) and to insure maintenance or improvement of quality habitat particularly during the application of herbicides. To protect water quality, chemicals are prohibited in the Riparian Management Zone (RMZ) & Water Protection Zone (WPZ) unless needed to move toward desired condition (USDA Forest Service 2005a, pages 2-4 and 2-5). A 10-acre area around cave entrances, including the area over known cave passages, is to be designated permanent old growth where vegetation management may "occur only as part of natural community management to reach desired conditions." (USDA Forest Service 2005a, page 2-12). Wetlands are also protected since the use of chemicals is prohibited within the established buffer zone of springs, seeps, fens, sinkholes, and shrub swamps, unless needed to meet specific restoration objectives (USDA Forest Service 2005a, page 2-13).

During development of the 2005 Forest Plan and analysis of potential impacts, the Mark Twain National Forest recognized the unique challenges of karst terrain and features (USDA Forest Service 2005, page 3-216 Geologic features and USDA Forest

Service 2005, pages 3-226 through 3-230) and the special habitat they provide to federal and state TES, as well as other more common wildlife species.

Based on addressing identified threats, a Species Viability Analysis process identified Conservation Approaches for Species at Risk (SAR). Conservation Approach G is to "Protect the structural and biological integrity of caves and reduce human disturbance to cave systems" (USDA Forest Service 2005, page 3-131). This Conservation Approach was identified as benefiting six of the 76 animal species and habitats evaluated. Specific standards and guidelines were developed for karst features that tend to carry water between surface and underground such as springs and sinkholes (USDA Forest Service 2005a, page 2-13). Primarily, these Standards and Guidelines (S&G) designate a buffer zone around these features within which management is constrained to insure protection of water quality.

Management Indicator Species (MIS): When assessing potential impacts to wildlife, the FS focuses on selected wildlife species, called Management Indicator Species (MIS), which represent guilds of species that use similar habitats.

Five species are used as Management Indicator Species (MIS) for this project analysis (Table 8). The proposed project areas fall within one or more of the MIS habitat components.

Table 11 Management indicator species and ecological indicators for the MTNF

Animals	Associated Conditions and Species
Northern Bobwhite (2)(5)	Grassland interspersed with shrubs; open woodlands; field sparrow (2); yellow-breasted chat; dickcissel (2)
Summer tanager (2)	Open woodland, prairie warbler (2)(3); eastern bluebird; spotted skunk (4)(5); red-headed woodpecker (2)
Bachman's sparrow (1)(2)(3)(4)	Open pine woodland, glades, brown-headed nuthatch; prairie warbler (2)(3); pine warbler
Worm-eating warbler (2)(3)	Forest interior; wood thrush (2)(3); Kentucky warbler (2); ovenbird (2); yellow-billed cuckoo (2); four-toed salamander; gray squirrel (5); southern flying squirrel; evening bat; luna moth
Red bat	Open and closed woodland; northern long-eared bat; Indiana bat; whip-poor-will (2)(3)
Natural Communities	Associated Conditions and Species
Glade	Red cedar invasion/lack diversity; Ozark woodland swallowtail; painted bunting (2); collared lizard; roadrunner; western pigmy rattlesnake; Missouri tarantula, many endemic plant species
Open woodland	Indiana bat (4)(6), fox squirrel (5), black bear, whip-poor-will (2)(3); Eastern wild turkey (5); white-tailed deer (5); eastern wood pewee (2); great-crested flycatcher (2); Osage copperhead; timber rattlesnake;

	three-toed turtle; Missouri woodland swallowtail
Groundwater seepage communities	Hydrologic regime; unique plant associations; swamp metalmark; ringed salamander; four-toed salamander; Hine's emerald dragonfly (6); Ozark snaketail dragonfly; Ozark emerald dragonfly, relict plants
(1) Regional Forester's Sensitive Species	
(2) Species for Ozark/Ouachita Physiographic region	
(3) Fish and Wildlife Service Species of Concern	
(4) Missouri Endangered species	
(5) Hunted. trapped species	
(6) Federal Endangered/Threatened species	

In addition to MIS, the Forest Service is mandated to minimize impacts to neotropical migratory birds. Those birds are represented by Partner's in Flight priority species for the Ozark-Ouachita Plateau (Physiographic Province 19), which encompasses all Mark Twain National Forest lands (http://www.blm.gov/wildlife/pl_19sum.htm). Many bird species of Partners in Flight conservation priority of have centers of abundance in this physiographic province. Various Neotropical migratory bird species, representing several habitat types, were addressed and included in Table 11 as "associated species." These species were specifically selected to represent habitats that include a wide variety of habitats across the MTNF, including grassland/early succession, deciduous mixed forest, pine forest, and riparian areas. This analysis will consider the effects, including cumulative effects, for each alternative on these MIS, and thus associated Neotropical migratory birds that may use the Mark Twain National Forest.

DIRECT AND INDIRECT EFFECTS ON WILDLIFE RESOURCES AND MIS

ALTERNATIVE 1 - NO ACTION

Alternative 1 is taking no new action to control NNIP. Some work would be done to treat NNIP from past decision documents.

Taking no action to control NNIP infestations would have no direct effects on wildlife, MIS or associated Neotropical migratory birds.

Failure to control NNIP infestations could indirectly affect wildlife resources or MIS habitat by degrading more and more acres of wildlife habitat. Invasive plants impact ecosystems by overgrowing and shading out native species, changing fire regimes, and modifying water or nutrient regimes (Simberloff 2010). Non-native plants that come to dominate an area can also cause "ecological replacement" where the NNIP comes to fill an ecological function for other organisms in the area (Pearson and Callaway 2003). Refer to the discussion on “Effects of No Management” (USDA Forest Service, 2005b) pages 3-74 through 3-75 and “Effects of Natural Community Restoration on Non-native Invasive Species” (USDA Forest Service, 2005b) on page 3-80.

Aggressive NNIP species tend to replace native plants upon which wildlife depend for food and cover. Although multiflora rose and Japanese honeysuckle provide minor to moderate food value to wildlife (USDA NRCS 2007a; 2007b), Borgmann and Rodewald (2004) found that northern cardinal and American robin nests placed in honeysuckle and multiflora rose bushes suffered higher rates of nest failure than those placed in native shrubs. They found that daily mortality rates were greater in these non-native shrubs, likely due to reduced nest height and larger shrub volume surrounding the nest, both of which may contribute to improved search efficiency by mammalian predators. In addition, Northern bobwhite, worm-eating warbler, and Bachman’s sparrow nest on the ground under shrubs, and may be subject to the same type of effect.

Specific to MTNF MIS and associated neotropical migratory birds, multiflora rose, Johnson grass, and autumn olive can significantly reduce areas of open grassland used by northern bobwhite; Johnson grass can replace native grasses on glades and open woodlands which reduces nesting and roosting cover for Bachman’s sparrow and northern bobwhite; sericea lespedeza replaces native grasses, sedges, and other flowering plants in several natural communities, which are food sources for various terrestrial insects, which in turn are prey for red bats. Finally, purple loosestrife forms dense, homogeneous stands that restrict native wetland plant species and could reduce open fen habitat for Hine’s emerald dragonfly.

Fraser and Crowe (1990) suggested that invasion of non-native plants have the capacity to disrupt native avian trophic assemblages, and in their study, they disclosed potential NNIP effects on avian nectivore-native plant pollination relationships. Nuzzo (2000) reported that garlic mustard might threaten some butterfly species. Adults of several native butterfly species lay eggs on garlic mustard, but many or all of the larvae die before completing development.

Simplification of the plant base also simplifies the insect food sources available, potentially reducing the number and variety of insect prey. Each of the MTNF MIS and associated neotropical migratory birds prey on a variety of terrestrial insects, some of which may be impacted by the simplification of their plant food sources as NNIP out-compete native plants, making less variety and number of prey available. Northern bobwhite, Bachman’s sparrow, summer tanager, and worm-eating warbler chicks feed on insects to get needed protein to fuel their early growth. Where NNIP out-compete native plant species, there may be a corresponding change in insects and a need for individuals of MIS and associated Neotropical migratory birds to use more energy to find adequate and nourishing food sources. This in turn leaves them less energy for reproduction and basic survival, particularly for the young.

Invasive aquatic plants and animals can also interact and facilitate one another (Simberloff 2010). For example, zebra mussels can alter aquatic habitat and provides favorable conditions for the invasive Eurasian water milfoil, which in turn provide more habitat (settling substrate) for zebra mussels. If the plant is moved from one body to another on a boat for instance, the zebra mussel also moves.

In general, species having relatively specific habitat requirements are more susceptible to adverse effects from the continued spread of NNIP species than would habitat generalists. For example, the white-tailed deer, a habitat generalist that favors edge habitats conducive to many NNIP species, would be less susceptible than the Bachman's sparrow, whose specialized glade/grassland habitat can be greatly altered by NNIP species such as autumn olive or Johnson grass.

With no treatment of NNIP on MTNF, there may be localized negative indirect impacts to individuals of MIS and other native wildlife species, including Neotropical migratory birds. These include simplification of food sources and degradation or reduction of quality cover and breeding areas. These changes would require individuals to use more energy to survive and reproduce, potentially resulting in reduced survival of individuals in a localized area. Even though individual NNIP sites on MTNF are currently scattered and relatively small-sized (0.3 acres to about 100 acres), lack of treatment increases the risk of spreading NNIP into other areas, and the resulting small habitat changes over a wide area may result in low-grade, long-term decreases in local populations of MIS or other native species.

ALTERNATIVE 2 – PROPOSED ACTION

Alternative 2 is an integrated approach to control NNIP infestations through a combination of mechanical, cultural, chemical, or biological methods.

Direct and Indirect Effects: Indirectly, control of NNIP through manual, mechanical, cultural, chemical or biological means could have beneficial effects to wildlife resources, MIS, and associated neotropical migratory birds by reducing competition with native plants, and maintaining or improving the amount and variety of native plants present in an area. This would result in maintenance or improvement of wildlife habitat conditions (see Alternative 1).

Manual and Mechanical: Grubbing, mowing, or cutting down shrubs/trees could remove or disturb bird nests or animal burrows. Most animals have the capability to leave the area temporarily if there is a disturbance, and thus would only be affected for a short time. Young animals, and some less-mobile species, may have a more difficult time escaping even a temporary disturbance. Northern bobwhite, Bachman's sparrow, and worm-eating warbler all nest on the ground and could be disturbed if activities were conducted during nesting seasons. Summer tanager chicks spend a few days on the ground after fledging and before learning to fly. Less mobile wildlife could be inadvertently injured or killed by people or equipment during control efforts.

Brief periods of noise and human activity could startle some wildlife, leading to temporary evacuation of areas where work is in progress and requiring additional expenditure of energy. However, most species are adapted to respond to potentially threatening situations and have evolved mechanisms to cope. With the small areas impacted by treatment and the short time period of human presence, it is likely that only individuals would be affected. Thus no effects on local or regional populations are expected.

Even if there were some localized and temporary adverse impacts to individuals of a species, the long-term beneficial impacts to species' habitats of removing NNIP from their environment would outweigh those minor negative effects.

Cultural: Using hot foam or a propane torch to kill plants would generally be done where control of individual plants, not large infestations, is needed. The technology makes it difficult to use this method unless the site is near a road with a nearby water source. Hot foam or torching is not used to start a fire, but to selectively burn the target NNIP. These methods would generally have the same effects on wildlife as grubbing, cutting, or hand pulling of plants. Some wildlife could be disturbed enough to temporarily leave the area; some less mobile species may be injured or killed by people/equipment used during NNIP treatment; and some bird nests or burrows may be damaged or destroyed by the treatment. With the small areas affected by treatment, and the short time period that there would be human presence, it is unlikely that impacts would affect enough individuals to have any effect on local or regional populations. Even if there were some localized and temporary adverse impacts to individuals of a species, the long-term beneficial impacts to species' habitats of removing NNIP from their environment would outweigh those minor effects.

Other cultural methods may include grazing NNIP with goats, cattle, or sheep. Grazing animals can be used to continually graze infestations to reduce biomass, prevent flowering and cause targeted plants to expend root reserves. Grazing of infestations may be used as the primary treatment or as an initial treatment to minimize leaf area to reduce herbicide application amounts and potential effects on non-target vegetation. While grazers would be introduced into areas with heavy infestations, it is possible they would consume some amount of native plant material. However, since it would be a relatively small and targeted area, this amount of native plant material is expected to be minimal and should be of little consequence to native wildlife species foraging in the localized area. If allowed free access to natural water sources, grazing mammals could degrade water sources when accessing them for drinking purposes, causing turbid water and silted substrates. Such conditions could reduce insect production, which could affect foraging of insectivorous wildlife species. However, Forest Plan standards and guidelines prohibit use of some natural waters for grazing purposes, and limit watering within the RMZ and WPZ (USDA Forest Service 2005a, page 2-21). Drinking sources can be provided to grazing mammals to avoid the need to use ponds, lakes, springs, or streams.

Biological: Biological control of invasive plants involves releasing animal species that feed on non-native plants. Six insects and one fungus (Table 6, Vegetation Section) are included in this alternative. Use of biological control agents would be appropriate on 1,404 acres. The plants targeted by these biological agents would be musk thistle, spotted knapweed, leafy spurge, and Eurasian water-milfoil.

The act of releasing biological control agents may affect wildlife resources, MIS habitat, or associated Neotropical migratory bird habitat. There are very few studies that have examined non-target and ecosystem effects from the release and establishment of biological control agents. Pearson and Callaway (2003) examine the indirect effects of biological control agents. They determined that the indirect effects may be as important as the direct effects (host shifting) of biological control usage.

The indirect effects include ecological replacement, compensatory responses, and food-web subsidies.

The United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) have permitted the insects proposed for use in Alternative 2 for release in the United States, under the Plant Protection Act of 2000. One species (milfoil weevil) is indigenous to the United States, including Missouri.

Issue B – The IDT was concerned about the unintended consequences on non-target species by releasing two weevils (*Larinus minutus/obtusus*) and root borer weevils (*Cyphocleonous achates*) that are host-specific to the spotted knapweed. Biological control of spotted knapweed in Missouri, begun in 2008 and involved the release of seedhead weevils at over 200 sites in Missouri. These releases were made by the Missouri Department of Transportation, Missouri Department of Conservation, and University of Missouri Extension. It will take several years for populations of these insects to grow enough to begin providing significant control of the spotted knapweed.

In Montana, Washington, uses of seedhead weevils and root borer weevils have been used as a bioagent for knapweed for over thirty years. No documented occurrence of these agents impacting native species has been documented. However, no monitoring studies geared at investigating the environmental impact of the releases were found during literature searches. The only studies found were effectiveness studies (i.e., were the weevils effective in controlling the target species). Releases of these biological control agents have also been made in Michigan, Minnesota, and Wisconsin within the last twenty years.

In Minnesota, the USDA released eleven biocontrol agent species in the state from 1989 through 2000 to manage this spotted knapweed. This included the seedhead and root borer weevils, which now, have well established population in the state. A study conducted from 2003-05 of Minnesota knapweed biocontrol sites showed a highest level of control when using the seed feeding weevils *Larinus minutes* and *L. obtusus* in combination with the root-feeding weevil, *Cyphocleonus achates*. There also has been no documented impact to non-target species in the state. However, as mentioned above, no monitoring studies investigating non-target effects were found.

In Missouri, there is only one native knapweed, American basket flower (*Centaurea americana*) that in the same genius as Spotted knapweed. The Missouri Department of Conservation list the American basket flower as a occurring historically in the state (Mo. Species and Communities of Conservation Concern 2011). There are no known populations of this species on the MTNF but there may likely be scattered individual plants on the MTNF. Both the seedhead weevils and the root borer weevils prefer large relatively dense populations of knapweeds. Other biological control species have been known to switch hosts especially within the same or closely related genera (Louda et al 1997), and it is not known whether the biological control agents proposed will switch to the native knapweed if released nearby.

Alternative 2 proposes to treat 34 populations of spotted knapweed, totaling 438 acres, with biological control agents. There are no known instances of American basket flower at those sites, or anywhere else on the MTNF. It is unlikely that release of the weevils would impact American basket flower.

Although most of these species are very host-specific, the leafy spurge beetles are known to occur on non-target plant species (Louda et al 1997). The beetles target plants in the sub-genus *Esula,* which has three native species in Missouri, none of which are federally, regionally or state listed. It is possible that these beetles might feed on non-target plants of the sub-genus *Esula*. While this would damage and possibly kill some plants, it is unlikely there would be any impact on local or regional populations of any of these three *Esula* species, due to their common occurrence in the state.

Design criteria have been developed to reduce the potential impacts of the release of biological control agents (TES7).

As noted for vegetation, the proposed biological agents have been demonstrated through research to adversely affect only the targeted NNIP species and other closely related taxa, with the few exceptions noted above. It is therefore unlikely that native plants upon which wildlife depends for food or cover would be adversely affected. Indigenous wildlife like the MIS noted above is generally adapted to depend upon regionally indigenous plant species as sources of food and cover. Plants introduced from other parts of the world, while typically beneficial to wildlife in that part of the world, are normally of less value to wildlife in the areas of introduction. For example, grazing animals avoid musk thistle because of its thorny leaves and stem (Jennings et al. ND). Introductions of biological control agents targeting musk thistle would therefore be expected to reduce dominance of musk thistle, creating areas dominated by native plants, which are of greater value as food and cover for wildlife. However, it is possible that some NNIP or even previously released biological control agents that have become established in an area may have displaced the ecological function of the native vegetation or insects (i.e., salt cedar in the southwestern US became habitat for the endangered southwestern willow flycatcher after it replaced the native willows the birds depended on – removing the salt cedar would cause long-term displacement of the birds until native willows were reestablished) (Pearson and Callaway 2003). There are no known such cases on the MTNF; however, this has not been studied either.

Since most of the biological controls are insects, it is possible that any of the five MIS or associated Neotropical migratory birds could consume some of the released insects. What impact this would have on an individual or species is unknown. Food-web interactions have just begun to be documented (Pearson and Callaway 2003). They noted studies that linked release of gallflies (*Urophora* spp.) for spotted knapweed control, led to increases in deer mice populations whose populations used to be limited by food availability. Studies documenting this type of food-web interaction have not been found for any of the species the MTNF is proposing to use.

Chemical: Wildlife species, including MIS and associated Neotropical migratory birds, could come in contact with herbicides by direct contact with spray streams or with recently treated foliage. Wildlife could also be exposed to herbicides by ingesting treated foliage, insects or other prey species, or through contact with treated water sources. Fish likewise can be exposed to herbicides in waters treated directly with herbicides and can be exposed if herbicides are used in adjacent wetlands or transported into waterways by surface runoff.

Herbicide toxicity data is presented in Table 9 below for mammals, birds, terrestrial invertebrates, aquatic organisms, and soil microorganisms. The data suggest that the herbicides proposed for use in terrestrial and aquatic settings are generally safe to wildlife if used in accordance with the manufacturer label. Research suggests there is low risk of bioaccumulation in the environment and food chain from use of the herbicides (SERA 2001; 2003a; 2003b; 2004a; 2004b, 2006; USDOI EPA 1995, 1998, 2005; Washington State 2006).

Table 12 Herbicide toxicity for mammals, birds, terrestrial invertebrates, aquatic organisms, and soil microorganisms.

2,4-D (SERA 2006)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	Adverse effects are plausible in mammals that consume contaminated vegetation or insects at typical and maximum application rates of 0.5 lb a.e./acre to 4 lbs. a.e./acre, but not at the lowest rate. However, there is no indication that substantial numbers of mammals would be subject to lethal exposure. Canines and other sensitive carnivorous mammals are more sensitive than other mammals. Birds appear to be much more tolerant than mammals and long-term exposure is unlikely to cause adverse effects. Adverse effects are a concern after acute exposure for birds. Adverse effects on terrestrial invertebrates may occur at the highest application rate of 4 lb a.e./acre.
Aquatic Organisms	2,4-D acids, salts, and esters are toxic to aquatic animals with esters having the most toxicity. Similar patterns of toxicity are observed for aquatic invertebrates and amphibians. However, application of 2,4-D acids or salts at typical Forest Service application rates of 0.5-4 lbs. a.e./acre) is likely to result in adverse effects on aquatic animals only in the event of an accidental spill. Application of 2,4-D esters however, may cause adverse effects due to runoff, direct application for aquatic weed control, and in cases of relatively large accidental spills.
Soil Microorganisms	Limited studies suggest that adverse effects on soil microorganisms are possible, particularly at the application rates above those typically used by the Forest Service.
Aminopyralid (SERA 2007)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	Adverse effects are not likely in mammals that consume contaminated vegetation or insects at typical and maximum application rates of 0.003 lb a.e./acre to 0.11 lbs. a.e./acre. Over the range of application rates and over the range of the estimated exposures, the hazard quotients for mammals range from 0.00001 (the lower bound for direct spray of a small mammal assuming first-order absorption at an application rate of 0.03 lb a.e./acre) to 0.07 (the consumption of contaminated insects by a small mammal after an application of 0.11 lb a.e./acre).
Aquatic Organisms	Aminopyralid has a low order of acute toxicity to aquatic animals, with acute NOEC (no-observed-effect-level) values falling within a narrow range: 50 mg a.e./L for sensitive fish to 100 mg a.e./L for tolerant fish. Acute toxicity values for amphibians and aquatic invertebrates fall within this range. Fish do not appear to be highly sensitive to aminopyralid and aminopyralid has been classified as practically nontoxic to fish by the U.S. EPA (U.S. EPA/OPP-EFED 2004, p. 27). The only information on amphibians is a NOEC of 95.5 mg a.e./L from a single acute limit test on northern leopard frog larvae (Henry et al. 2003a). This value is very similar to the 100 mg a.e./L for tolerant species of fish. Based on the limited amount of studies, the most that can be said is that the very limited acute toxicity data on

	amphibians indicate that leopard frog larvae are no more sensitive to aminopyralid than fish.
Soil Microorganisms	Based on one study, there does not appear to be a basis for suggesting that adverse effects on soil microorganisms are plausible. In this study, the only effects associated with aminopyralid concentrations of up to 8.4 mg a.e./kg soil were transient and modest increases in nitrate and total mineral nitrogen concentrations in soil. These increases were statistically significant only on Day 0 of the study – i.e., the day that the aminopyralid was applied – and no statistically significant effects were noted on Days 7, 14, and 28 of the study.
Clopyralid (SERA 2004a)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	No adverse effects are anticipated in terrestrial animals from the use of clopyralid in Forest Service programs at the typical application rate of 0.35 lb a.e./acre. The same holds for the maximum application rate of 0.5 lb a.e./acre, except for large birds or mammals feeding exclusively on contaminated vegetation over a long period of time (i.e., 90 days). The scenarios assume that the vegetation is treated and that the animal stays in the treated area consuming nothing but the contaminated vegetation. Given that most forms of vegetation would likely die or at least be substantially damaged, this exposure scenario is implausible. It is, however, routinely used in Forest Service risk assessments as a very conservative upper estimate of potential exposures and risks. The longer term consumption of vegetation contaminated by drift or the longer term consumption of contaminated water or fish – yield hazard quotients that are in the range of 0.00005 to 0.02, far below a level of concern.
Aquatic Organisms	Clopyralid appears to have a very low potential to cause any adverse effects in any aquatic species.
Soil Microorganisms	Maximum concentration of clopyralid in soil will be in the range of 0.2 to 0.25 mg clopyralid/kg soil at an application rate of 1 lb a.e./acre. At the maximum application rate of 0.5 lb a.e./acre, the estimated maximum soil concentrations would be in the range of 0.1 to 0.125 mg clopyralid/kg soil. These projected maximum concentrations in soil are far below potentially toxic levels.
Dicamba (SERA 2004c)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	No adverse effects are anticipated in terrestrial animals from the use of dicamba in Forest Service programs at the typical application rate of 0.3 lb a.e./acre. The same holds for the maximum application rate of 2 lb a.e./acre except that reproductive effects is plausible for birds or mammals feeding on contaminated vegetation or insects at this application rate. However, even this scenario yields hazard quotients that are below the level of concern by factors of 5 to over 16,000. Small animals seem to be less sensitive to dicamba than larger animals.
Aquatic Organisms	Dicamba is relatively non-toxic with the most sensitive species appear to be rainbow trout, with some species of aquatic invertebrates more sensitive than fish, and amphibians similar to fish in sensitivity. The lack of toxicity data specific to aquatic organisms makes it difficult to characterize risk for aquatic organisms. However, there is little basis for asserting that adverse effects are plausible.

Soil Microorganisms	No adverse effects are expected at the typical application rate. At the highest application rate, short-term effects might occur in some populations.
Endothall (Environmental Protection Agency, 2005)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	This herbicide would only be applied to water to control aquatic invasive plants. The expected persistence in water is about 10 days. There is no information about how animals would be affected after drinking treated water.
Aquatic Organisms	Endothall dipotassium salt is the only form labeled for use in controlling water milfoil and pondweeds (EPA 2005). It is considered slightly toxic to practically non-toxic to freshwater fish. Acute and chronic adverse impacts may occur to freshwater fish and invertebrates at maximum application rates. May be potential for indirect effects to species in any taxa that are dependent upon taxa that may experience effects from use of endothall.
Soil Microorganisms	No impact is expected from aquatic applications of endothall.
Fosamine ammonium salt (Environmental Protection Agency, 1995)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	Fosamine ammonium is practically non-toxic to honey bees, avian species, and small mammals. Adverse acute or chronic effects are not anticipated from present label uses. There is some question as to whether or not there may be chronic reproductive impacts on waterfowl when eggs are directly exposed to sprays and another study is required. Tests with northern bobwhite eggs showed no impacts at any dose level.
Aquatic Organisms	Fosamine ammonium is practically non-toxic to cold and warm water fish and freshwater invertebrates. Acute effects are not expected as a result of normal use of fossamine ammonium, and it is reasonable to assume no chronic effects to aquatic organisms.
Soil Microorganisms	Fosamine ammonium is rapidly degraded (1/2 to 4 days) in aerobic and anaerobic environments by soil microbes.
Fluroxypyr (Environmental Protection Agency, 1998; Washington State 2006)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	Practically non-toxic to honey bees and birds on an acute and dietary basis. Slightly toxic to small mammals. This herbicide does not bioaccumulate in mammals or bioconcentrate through the food chain. At typical application rates and considering the small amount of area to be treated, there is an insignificant risk to mammals and birds and no adverse effects are anticipated.

Aquatic Organisms	Slightly toxic to freshwater fish. Practically non-toxic to freshwater aquatic organisms. (Note – Fluoride Action Network considers Fluroxypyr 1-n to be highly toxic to crustaceans and zooplankton). This is a terrestrial herbicide, so exposure would be through surface runoff, leaching into groundwater, or application drift. Because of relatively low toxicity, application rates, and persistence, risk of adverse effects is considered to be low.
Soil Microorganisms	Microbes and sunlight break down fluroxypyr in the environment and limit the downward leaching of this herbicide. It is generally not found below 6 inches soil depth.
Glyphosate (SERA 2003a)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	Effects to birds, mammals, fish and invertebrates are minimal. Based on the typical application rate of 2 lbs a.e./acre, none of the hazard quotients for acute or chronic scenarios reach a level of concern even at the upper ranges of exposure. For the application rate of 7 lbs a.e./acre, there is some level of concern with direct spray of honey bees, for large mammals consuming contaminated vegetation, and small birds consuming contaminated insects. These concerns are based on conservative dosing studies and environmental conditions that are not likely to occur in the field.
Aquatic Organisms	Some formulations of glyphosate are much more acutely toxic to fish and aquatic invertebrates than technical grade glyphosate or other formulations of glyphosate. This difference in acute toxicity among formulations appears to be due largely to the use of surfactants that are toxic to fish and invertebrates.
Soil Microorganisms	Transient decreases in the populations of soil fungi and bacteria may occur in the field after the application of glyphosate at application rates that are substantially less than those used in Forest Service programs. Several field studies have noted an increase rather than decrease in soil microorganisms or microbial activity, including populations of fungal plant pathogens, in soil after glyphosate exposures. While the mechanism of this apparent enhancement is unclear, it is plausible that glyphosate treatment resulted in an increase in the population of microorganisms in soil because glyphosate was used as a carbon source and/or treatment with glyphosate resulted in increased nutrients for microorganisms in the soil secondary to damage to plants.
Sethoxydim (SERA 2001)	
Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	No adverse effects can be anticipated in terrestrial animals from the use of this compound in Forest Service programs.
Aquatic Organisms	There is no indication that fish, aquatic invertebrates, or aquatic plants are likely to be exposed to concentrations of sethoxydim that will result in toxic effects.
Soil Microorganisms	At sethoxydim concentrations <50 ppm, negligible response was noted in microbial populations. At higher concentrations (1000 ppm), soil actinomycetes and bacteria populations were stimulated, but fungal populations changed little.
Triclopyr (SERA 2003b)	

Mammals, Birds, and Terrestrial Invertebrates (includes all MIS and associated neotropical migratory birds)	Contaminated vegetation is primary concern in the used of triclopyr and that high application rates will exceed the level of concern for both birds and mammals in longer term exposure scenarios.
Aquatic Organisms	At an application rate of 1 lb/acre, acute and chronic risks to aquatic animals, fish or invertebrates, as well as risk to aquatic plants are low with use of the salt form of triclopyr. At the highest application considered in this risk assessment, 10 lbs a.e./acre, the risks to aquatic animals remain substantially below a level of concern. The ester form of triclopyr is projected to be somewhat more hazardous when used near bodies of water where runoff to open water may occur.
Soil Microorganisms	The potential for substantial effects on soil microorganisms appears to be low. An application rate of 1 lb/acre is estimate to result in longer term soil concentrations that are well below 0.1 ppm – i.e., in the range of about 0.02 to 0.05 ppm – and peak concentrations in the range of about 0.2 ppm. Thus, if the laboratory studies are used to characterize risk, transient inhibition in the growth of some bacteria or fungi might be expected. This could result in a shift in the population structure of microbial soil communities but substantial impacts on soil – i.e., gross changes in capacity of soil to support vegetation – do not seem plausible. This is consistent with the field experience in the use of triclopyr to manage vegetation.

None of the proposed herbicides are cholinesterase inhibitors such as organophosphate or carbamate insecticides (or chemically related to such insecticides) that are highly toxic to wildlife, especially insects and other invertebrates. None of the proposed herbicides are chemically related to the chlorinated hydrocarbon insecticides such as DDT that are highly persistent in the environment and known for causing eggshell thinning of raptors (birds of prey) such as bald eagles and ospreys.

Potential Impacts to Water and Karst: Chemical control methods involving spraying herbicides could expose soils and surface water to herbicides, even if applied following label directions. Herbicides that fall on soil during spray operations can leach into groundwater or be transported in surface runoff, where they are available as drinking water to terrestrial animals, or may come in contact with aquatic animals. This is especially true in areas with karst features, such as sinkholes, some of which are direct conduits to the groundwater system and cave habitats. Many of the proposed herbicides are designed to rapidly break down into inactive products in soils and water. However, in areas with direct karst connections between surface and groundwater, herbicides and their residues may be able to migrate with little or no adherence to soil particles or degradation before reaching cave habitats. Cave animals may be exposed to herbicides or their residues in water flowing through caves, or drinking contaminated water. However, the application of Project Design Criteria will greatly minimize the likelihood of herbicides moving offsite.

With no information on how these herbicides affect cave invertebrates, we have to extrapolate from information on terrestrial and aquatic invertebrates. When applied at typical application rates for the Forest Service, terrestrial invertebrates are unlikely to be adversely affected by any of the herbicides proposed. Adverse effects on terrestrial invertebrates could occur with the highest application of 2,4-D. Adverse impacts to aquatic invertebrates would only be expected at the highest application rates for endothall (an aquatic use herbicide), and in cases of accidental spill of 2,4-D. Esters of 2,4-D may cause adverse effects due to runoff, direct application for aquatic weed control, and in cases of relatively large accidental spills. The highest risk for adverse impacts to cave invertebrates would be an accidental spill of 2,4-D or endothall directly into a sinkhole or area of diffuse recharge. In such a case, it is possible that cave animals could be injured or killed. How many, or what the total impact on the cave and its inhabitants would be, is unknown. While possible, this scenario is highly unlikely due to label directions, Forest Plan standards and guidelines, and Project design criteria that would greatly reduce the risk of this scenario occurring (see TES 4, 10, 11 and SW 1)

Should herbicides enter surface water, their concentration would quickly decline because of mixing and dilution, volatilization, and degradation by sunlight and microorganisms (van Es 1990). This may not be true for karst areas with a high concentration of discrete and diffuse recharge features (See previous paragraph for discussion of potential impacts to cave habitats).

Potential Impacts to Fish & Aquatic Animals: Most of the herbicides proposed for use under Alternative 2 are of low toxicity to fish and aquatic invertebrate species and have been demonstrated to pose little toxicological risk to fish and wildlife when used at application rates typical for the Forest Service. However, some formulations of triclopyr (ester form) and some surfactants used with glyphosate (terrestrial form) are toxic to fish and aquatic invertebrates. Care would be taken during application to ensure that this herbicide and the surfactants do not enter aquatic resources. Label directions would be followed to prevent or minimize any groundwater and surface water contamination from mobile chemicals. Herbicide treatment in riparian areas would follow label direction, specified design criteria, and Forest Plan direction to protect aquatic resources. When herbicides are used according to label specifications, no substantial long-term impacts to water quality or aquatic habitats are expected. Project design criteria have been developed to minimize or eliminate adverse affects to fish and aquatic animals (see especially GH4 and 15, TES 4, 6, 7, 10, and 11 and SW6).

Potential Impacts to Insects: Although none of the proposed herbicides are considered to be insecticidal, the toxicity data for terrestrial invertebrates and ecological risk information suggest that 2,4-D and dicamba could adversely affect honeybees and pollinating insects inadvertently exposed to those herbicides. The other herbicides pose little risk when used at average FS rates (no information is available on endothall toxicity to insects, but it is applied directly to water and therefore honeybees and most pollinating insects are not typically exposed). However, careful effort to direct spray streams straight at target vegetation and to minimize drift and runoff of herbicides should minimize exposure of honeybee and pollinator populations to 2,4-D and dicamba.

Potential Impacts to Reptiles & Amphibians: Globally, many amphibian and some reptile populations have experienced population declines. Habitat destruction, alteration and fragmentation are likely the primary causes (Dodd and Smith 2003). Other suspected causes include the introduction of non-native species, overexploitation, climate change, increased UV-B radiation, emerging infectious diseases and deformities (several authors in AmphibiaWeb 2008). However, another of the suspected cause of declines is use of herbicides (insecticides, herbicides, and fungicides). There is a growing body of evidence that chemical uses can cause lethal, sublethal, direct and indirect effects on many species of amphibians and reptiles and that the tests normally done for other species may not adequately represent potential impacts on these taxa (AmphibiaWeb 2008).

Within the 29 counties containing MTNF lands, there are 50 amphibian and 68 reptile species (MOFWIS 2011). Fifteen amphibian and eight reptile species within these counties are included on Missouri's Species of Conservation Concern checklist January 2011 (MDC 2011). Note that within the 29 counties that contain MTNF lands, on average, National Forest lands comprise only 11% of the 29-county area (USDA Forest Service 2005a). These species would be subject to the same potential impacts of chemical use as described for general wildlife in the first paragraph of this section, i.e. individuals could come in contact with herbicides by direct contact with spray streams or with recently treated foliage, or could be exposed to herbicides by ingesting treated foliage, insects or other prey species, or through contact with treated water sources. While the data suggest that the herbicides proposed for use in terrestrial and aquatic settings are generally safe to wildlife if used in accordance with the manufacturer label, this is apparently less certain for long-term effects on amphibians in particular than for other groups of species on which research has been done. However, adherence to label direction, Forest Plan standards and guidelines and Alternative 2 Project design criteria would minimize the potential for inadvertent exposure of amphibians and reptiles to spray streams. None of the NNIP control activities proposed as part of Alternative 2 would contribute to the loss or degradation of wetlands or other amphibian or reptile habitats or to other activities suspected of contributing to amphibian decline. In fact, NNIP control, in some cases, would improve the quality of wetland habitats.

Potential Impacts to MIS and Associated Neotropical Migratory Birds: Four of the five MIS are bird species, which eat insects and plant material, and use vegetation for nesting, roosting, and escape cover. For the herbicides listed in Table 17, there is some concern for birds when application rates are high. For application rates at the low or moderate rate, there does not appear to be concern for adverse acute or chronic effects to birds, except for a question about waterfowl reproductive impacts of fossamine ammonium. However, northern bobwhite eggs were also tested and had no adverse reaction. Several of the herbicides do pose a concern for acute and/or chronic effects to birds at the highest application rates. Consuming contaminated insects is a concern for small birds with at least one of the herbicides. However, these concerns are based on conservative dosing studies and environmental conditions that are not likely to occur in the field. As described in Alternative 1, the impact to MIS habitats and associated neotropical migratory bird habitats from removal of NNIP is beneficial to all the species.

MIS red bat is also an insect eater, and while there were few concerns for acute or chronic impacts to small mammals from typical application rates of the herbicides in Table 17, it is logical to assume that consumption of contaminated insects might also have impacts to red bats. Some concerns were expressed for small mammals consuming contaminated vegetation or insects at high application rates, particularly for 2,4-D. However, even for 2,4-D there is no indication that substantial numbers of mammals would be subject to lethal exposure. And, as for birds, the studies tend to use dosing estimates and environmental conditions that are not likely to occur in the field.

Even for herbicide formulations regarded as toxicologically and environmentally safe, proper application in strict accordance with the manufacturer label is critical to ensure safety to the applicator and the environment. In all applications, Forest Plan standards and guidelines, label directions, and specific measures (see project design criteria) would be applied to reduce the risk of herbicide transfer to soil, water, and cave resources.

In conclusion, application of methods to reduce, control, or eliminate infestations of NNIP on MTNF, may result in some short-term, localized adverse impacts to individual animals of various species from activities associated with NNIP treatment, but no impact is expected to result in long-term changes in the local or regional populations of any species. The Forest Plan analysis on page 3-139 (USDA Forest Service 2005a) concluded that there are unlikely to be direct or indirect effects of herbicide use due to implementation of strict standards and guidelines.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

Alternative 3 is a coordinated approach to controlling NNIP infestations through the use of manual, mechanical, cultural, and biological means. No herbicides would be used in this alternative.

Manual, mechanical, cultural and biological controls would be used, but no herbicides would be used with implementation of Alternative 3. The effects disclosed for physical, cultural and biological control of NNIP under Alternative 2 would apply for Alternative 3.

Issue B – Since root weevils (*Cyphocleonus achates*) or seed head weevils (*Larinus minutus, Larinus obtusus*) would not be released in this alternative, there would be no impacts to non-target species such as the American basket flower.

It is anticipated that the proposed control methods described in Alternative 3 would result in reduction or eradication of NNIP species within treated areas, but perhaps not as completely or effectively as Alternative 2, since some NNIP would be difficult if not impossible to control without the use of herbicides.

SUMMARY OF POTENTIAL IMPACTS TO MIS AND ASSOCIATED NEOTROPICAL MIGRATORY BIRDS

Red bats and associated species that are nocturnal and insectivorous (i.e. whip-poor-will)

Alternative 1 (No Action): Little direct effect. Possible long-term simplification of plant & insect food sources could lead to adverse indirect effects.

Alternative 2 & 3 (Proposed Action): Possible short-term, localized adverse impacts to individuals, particularly from ingestion of insects (bat) or seed (bird) affected by herbicide. Roosting red bats could be impacted if using treated vegetation or it may ingest herbicides while grooming.

Whip-poor-will could also be impacted as nests may be disturbed during treatments. Long-term impacts to local or regional populations are unlikely to occur. Beneficial impacts to habitat from removal of NNIP may occur. Alternative 3 is similar to Alternative 2, except that no impacts from herbicide would occur.

Summer tanager and associated species that are omnivorous birds, are shrub/tree nesters and feed on seeds (i.e. Prairie warbler, eastern bluebird, red-headed woodpecker, eastern wood pewee, great-crested flycatcher)

Alternative 1 (No Action): Little direct effect. Possible long-term simplification of plant & insect food sources could lead to adverse indirect effects,

Alternative 2 & 3: Possible short-term, localized adverse impacts to individuals, particularly from ingestion of insects or seed coated with herbicide, or from nests being disrupted during treatments. Long-term impacts to local or regional populations are unlikely to occur. Beneficial impacts to habitat from removal of NNIP may occur. Alternative 3 is similar to Alternative 2, except that no impacts from herbicide would occur.

Northern bobwhite and associated species that are omnivores, birds ground nesters and feed on herbaceous vegetations (i.e. field sparrow, yellow-breasted chat, dickcissel, painted bunting).

Alternative 1: Little direct effect. Possible long-term simplification of plant & insect food sources could lead to adverse indirect effects,

Alternative 2 & 3: Possible short-term, localized adverse impacts to individuals, particularly from disturbance to ground nests during treatment, or from ingestion of insects or plant material coated with herbicide. Beneficial impacts to habitat from removal of NNIP may occur Alternative 3 is similar to Alternative 2, except that no impacts from herbicide would occur.

Worm-eating warbler and associated species that omnivorous, ground nester and feed on seeds (i.e. wood thrush, Kentucky warbler, ovenbird, yellow-billed cuckoo).

Alternative 1 (No Action): Little direct effect. Possible long-term simplification of plant & insect food sources could lead to adverse indirect effects,

Alternative 2 & 3: Possible short-term, localized adverse impacts to individuals, particularly from ingestion of insects or seed coated with herbicide, or from nests being disrupted during treatments. Long-term impacts to local or regional populations are unlikely to occur. Beneficial impacts to habitat from removal of NNIP are more likely. Alternative 3 is similar to Alternative 2, except that no impacts from herbicide would occur.

Bachman's sparrow and associated species that are omnivorous, ground nesting and feed on vegetation (i.e. brown-headed nuthatch, prairie warbler, pine warbler)

Alternative 1 (No Action): Little direct effect. Possible long-term simplification of plant & insect food sources could lead to adverse indirect effects.,

Alternative 2 & 3: Possible short-term, localized adverse impacts to individuals, particularly from ingestion of insects or seed coated with herbicide, or from nests being disrupted during treatments. Since so few individuals in Missouri, any impact to individuals may have adverse impacts on local populations. Beneficial impacts to habitat from removal of NNIP may occur. Alternative 3 is similar to Alternative 2, except that no impacts from herbicide would occur.

Summary of the cumulative benefits from controlling NNIP infestations

Alternative 1 (No Action): Taking no action to control NNIP would not result in direct impacts to wildlife or fish. However, failure to control NNIP infestations would allow continued degradation of habitat which is expected to reduce their value & function, and may result in localized decreases in some species' populations.

Alternative 2 (Proposed Action): NNIP control methods could pose some localized, short-term adverse effects on individuals of wildlife species or their habitats. Only herbicide formulations labeled for use in or near aquatic areas would be sprayed in or near waters, wetlands, or riparian areas. Beneficial impacts to habitat from removal of NNIP may occur.

Alternative 3 (No Herbicide): Some NNIP infestations would not be effectively controlled since no herbicides would be used. Impacts to wildlife and fish would be a combination of Alternatives 1 & 2 – more similar to Alternative 1 where infestations did not respond to treatments other than herbicide; more similar to Alternative 2 where NNIP respond to treatments other than chemical. Beneficial impacts to habitat from removal of NNIP may occur.

CUMULATIVE EFFECTS ON WILDLIFE RESOURCES

The cumulative effects analysis area for wildlife resources, MIS habitat, and associated Neotropical migratory bird habitat is the MTNF proclamation boundary. This analysis area was chosen because it includes all areas proposed for NNIP treatments under Alternatives 2 and 3 and areas that may need treatment in the future. This boundary would also encompass any lands that have yet to be acquired by the Forest Service, but which may need rapid response treatments to order to reduce the risk of spread of NNIP. The cumulative effects analysis timeframe is 10 years, because this timeframe coincides with the current Forest Plan planning cycle and this timeframe allows for initial and subsequent treatments of NNIP infestations to occur. This is also the timeframe in which one could expect to see measurable results across the Forest.

Wildlife habitat found in the analysis area today is a result of various land management activities that occurred over the past century. Lands were cleared for agriculture, mining, and development. As the lands were cleared and developed, water quality and aquatic habitat were degraded by silt, animal waste, and heavy metals from mining operations. As forest cover began to once again increase over the past half century, water quality and aquatic habitat within the cumulative effects analysis area have improved in recent years. Water quality of both aquifers underlying the MTNF is considered good, according to Missouri Department of Natural Resource standards (USDA Forest Service 2005b, page 3-227). Water quality in surface waters meets state standards for full body immersion, and is generally considered good (USDA Forest Service 2005b, page 3-225). Seven water bodies are on the state's Section 303(d) impaired water listing, but the problems identified are not a result of forest management activities (USDA Forest Service 2005b, page 3-225). Herbicides are not listed as a cause of water quality impairment for the watersheds in the analysis area.

Decades ago, some NNIP were purposely brought into the analysis area to improve wildlife habitat (e.g., multiflora rose, honeysuckle) or to control erosion (e.g., sericea lespedeza). Over the years, these plants were dispersed by people, animals, wind, and water. Within the past 5-10 years, the kinds of NNIP in the analysis area have increased tremendously. Most of these plants are spreading into and through the analysis areas. While many agencies are working to expand the publics' knowledge of NNIP and their dangers (see http://www.mdc.mo.gov/), new species are expected to move into the analysis area in the future. Land managers are now becoming more and more aware of the possible negative impacts of NNIP to oak regeneration, native vegetation and wildlife habitat.

Manual, mechanical, cultural, biological, or chemical control measures would not be used under Alternative 1, therefore this alternative would not directly contribute to any adverse cumulative impact to wildlife resources, MIS habitat, or associated neotropical migratory bird habitat.

However, failure to control NNIP on NFS lands could indirectly contribute to a cumulative increase in habitat degradation on both federal and non-federal lands during the cumulative effects analysis time period. Habitat degradation would impact the various habitats for all five of the MTNF's MIS, as well as the associated Neotropical migratory birds, in localized areas on both federal and non-federal lands. Northern bobwhite has been declining in numbers in Missouri over the past 20 years (Sauer et al 2007) and local populations could potentially be negatively affected by a lack of action to control NNIP. Bachman's sparrow populations in Missouri are too low to track during Breeding Bird Survey routes (Sauer et al 2007), and failure to control NNIP could severely impact the remaining habitat in Missouri. Summer tanager and worm-eating warbler are at more stable population levels in Missouri (Sauer et al 2007), and the failure to control NNIP on MTNF lands would probably not impact more than individuals in small, localized areas. Although red bats have probably declined dramatically from historic levels, they are still the most abundant bat captured on MTNF and are one of the most abundant bats in many parts of their range (Bat Conservation International 2001). Failure to control NNIP on MTNF lands would probably not impact more than individuals in small, localized areas.

Physical (mowing, weed eating, hand pulling) and cultural controls (livestock) have been used on non-federal lands to control unwanted plants, but not necessarily to control NNIP. This continues today, and is likely to continue into the foreseeable future. Limited NNIP control, primarily bushhogging, has occurred on non-federal lands to control plants (i.e. multiflora rose) interfering with livestock or hay production. It is possible that additional NNIP treatment may occur in the future on non-Federal lands as education and information efforts hit their mark, or as landowners realize the damage being done by NNIP to their livelihood or property values. In fact, some adjacent landowners have complained to the Forest Service in the past regarding the failure of the Forest Service to control NNIP on federal lands adjacent to their property (J. Eberly, D. Moore, pers. knowledge) due to the risk of the plants spreading onto private property.

Manual, Mechanical, and Biological: Forest Service employees and volunteers have used manual and mechanical controls on several thousand acres of NFS lands in the past to control garlic mustard, multiflora rose, autumn olive, musk thistle, and sericea lespedeza. The Forest Plan has an objective of controlling a minimum of 2,000 acres of existing infestation over the plan period. There have been no biological controls initiated on MTNF lands in the past.

Manual, mechanical, and biological control methods proposed as part of Alternative 2 may result in some relatively short-term and localized effects such as injury or death to individual animals of a variety of taxa. But, because the areas treated are relatively small and scattered, treatments would follow label direction, Forest Plan standards and guidelines, Project design criteria, and the herbicides used are considered generally safe to wildlife when used according to label direction, long-term impacts to species' populations are essentially negligible, and would contribute little or no incremental effect when combined with impacts of other past, present, and reasonably foreseeable future activities identified under Alternative 2. Consequently, manual, mechanical, and biological activities in Alternative 2 are not expected to contribute substantially to any measurable decrease in species' populations.

Cultural: Cultural control methods proposed as part of Alternative 2 may result in some relatively short-term and localized effects such as injury or death to individual animals of a variety of taxa. But, because the areas treated are relatively small and scattered, treatments would follow Forest Plan standards and guidelines, and project design criteria, and the resulting improvement in habitat would be beneficial to most wildlife species, long-term impacts to species' populations are essentially negligible, and would contribute little or no incremental effect when combined with impacts of other past, present, and reasonably foreseeable future activities identified under Alternative 2. Consequently, cultural activities in Alternative 2 are not expected to contribute substantially to any measurable decrease in species' populations.

Chemical: Herbicides have been used extensively in both the past, as well as present, to treat NNIS on non-Federal lands. Many private landowners purchase sprays (e.g., Roundup®) from local retailers and apply them to their gardens, lawns, driveways, and patios. Some farmers apply herbicides seasonally to their pastures and hay fields with boom sprayers. Highway departments apply herbicides to roadsides to promote safety and more recently to control NNIP, and utility companies routinely spray corridors to protect underground and surface transmission lines. Managers of industrial forest lands have used herbicides for silvicultural reasons (i.e., basal spray to release pine plantations, and broadcast aerial spraying in clearcuts to prepare for pine planting). Herbicides will continue to be used on non-federal lands for these purposes in the foreseeable future and most likely at current levels and intensities. It is possible that herbicides could be used on non-federal lands to purposefully treat NNIP to increase pasture areas, but the amount of treatment is expected to be minimal. Herbicides used to treat NNIP may be cost prohibitive to many private landowners.

Herbicides were used on National Forest lands in the 1950s until about 1980 to prepare sites for tree planting, to release young trees to grow, to create semi-open wildlife habitat, and for powerline right-of-way management (Ameren UE). Herbicides have been and are currently used to treat poison ivy in campgrounds and recreation areas on the MTNF, noxious weed control, and some research projects associated with the Sinkin Experimental Forest. Currently, there are several projects with decisions that include some herbicide treatment for terrestrial and aquatic NNIP, and recent Forest Service project decisions will enable the Forest Service to use herbicides to treat NNIP on 236 acres in the project areas. Forest Plan Objective 1.2a is to "Control a minimum of 2,000 acres of existing noxious or non-native invasive species over the plan period." (USDA Forest Service 2005a, page 1-3).

In most of the areas where herbicides would be used, with respect to chemical treatment methods described in Alternative 2, the proposed herbicides quickly degrade in terrestrial and aquatic systems by natural processes, exhibit low toxicity to a majority of terrestrial and aquatic species, and do not bioaccumulate to significant levels. Areas that would be affected by herbicide treatment are relatively small in size and scattered across the Forest landscape. As a result of the Project design criteria, the herbicide impact on non-target wildlife species would be relatively small. The proposed herbicide treatments would therefore contribute only a marginal adverse incremental effect when combined with impacts of other past, present and reasonably foreseeable future activities. Consequently, herbicide use under Alternative 2 is not expected to result in a substantial increase in adverse cumulative effects to non-targeted wildlife, MIS, or associated neotropical migratory bird ha It is anticipated that the proposed control methods described in Alternative 2 could result in a substantial reduction or eradication of NNIP species within treated areas. Cumulative benefits from controlling NNIP infestations would include protecting native species, including MIS and associated neotropical migratory birds, threatened, endangered, and sensitive species, and their habitats.

THREATENED, ENDANGERED, AND SENSITIVE SPECIES

AFFECTED ENVIRONMENT

In the Biological Evaluation for this project, the effects of the proposed alternatives were analyzed for eight endangered (E), two threatened (T), three candidate species, and two proposed endangered(PE), designated critical habitat (Table 20), 45 Regional Forester Sensitive Animal Species, and 94 Regional Forester Sensitive Plant Species. The affected environment for these analyses included the entire Mark Twain National

Forest because NNIP locations are scattered across the Forest. Weed treatment actions on lands of other ownership were considered in the analyses but such information is limited.

Habitats on the Mark Twain National Forest are diversified. Most of this land is within the Ozark Highlands, a region long distinguished for its extraordinary geological, hydrological, and ecological diversity. Signature features of the Ozarks Highlands include crystal-clear springs, thousands of caves, rocky barren glades, ancient volcanic mountains and several National Scenic Rivers.

The Ozark Highlands are deeply dissected by clear flowing, often spring-fed, moderate to high-gradient streams and rivers, and the Mark Twain National Forest occurs in five of the seven major river basins in the Missouri portion of the Ozark Highlands (Figure 5). Eleven primary streams and rivers course through these basins, portions of which occur within the boundaries of the Mark Twain National Forest. Because of the region's karsts topography, the Ozark Highlands are home to the world's largest collection of first magnitude6 springs. Almost 3,000 springs in the Ozark Highlands feed rivers and streams that flow year-round. In the Ozark Highlands, eastern upland oak hardwood and southern pine woodlands converge with drier western tallgrass prairie, creating a distinctive array of open grassy woodlands and savannas (USDA Forest Service Forest, 2005b).

The U.S. Fish and Wildlife Service's most recent letter, dated January 7, 2011, lists eight endangered (E), two threatened (T), two proposed endangered and three candidate species as occurring within or adjacent to the MTNF. They are: gray bat (E), Hine's emerald dragonfly (E), Indiana bat (E), Mead's milkweed (T), Ozark hellbender (PE) running buffalo clover (E), scaleshell mussel (E), spectaclecase (C), sheepnose (C), rabbistfoot (C), pink mucket pearly mussel (E), Curtis pearly mussel (E), Tumbling Creek cavesnail (E), and Virginia sneezeweed (T) (Ta). In addition, critical habitat for the Hine's emerald dragonfly has been designated on the MTNF. Each of the 13 federal/candidate species requires unique habitats (caves, abandoned mines, springs, acid seeps, calcareous fens, shrub swamps, sinkhole ponds, rock bluffs, cliffs, outcrops, or other forms of permanent water) during all or a portion of their life cycle.

There are 18 documented caves on the Mark Twain National Forest that are known to harbor gray bats during part or all of the year (Missouri Department of Conservation, 2004) and there are five Indiana bat caves located on the MTNF. Only one cave (on private land) harbors the endangered Tumbling Creek cavesnail.

Six calcareous fens have documented occurrences of NNIP. Five of these calcareous fens have documented Hine's emerald dragonfly larvae, and one is documented with adult Hines emerald dragonfly. In addition, the Black, Gasconade, Meramec, Big Piney, Current, Eleven Point, and North Fork of the White River support aquatic T and E species across the MTNF.

There are 139 Regional Forester Sensitive Species (RFSS) on the MTNF; 45 are animal species, and 94 Regional Forester Sensitive Plant Species. These include mammals, birds, amphibians, one reptile, fish, mollusks, insects, invertebrates, and

[6] First magnitude springs are those springs that have over 65 million gallons of water flow daily.

vascular and non-vascular plants. Although the majority of the 139 RFSS plants and animals can be found in similar “unique” habitats such as glades, acid seeps, or calcareous fens, a few RFSS are generalists and require habitats that are more common or those habitats more easily created or maintained through forest management practices. These habitats include but are not limited to upland oak hickory woodlands, bottomland/riparian woodlands and forests, snags/hollow trees, open or brushy areas, buildings, open pine woodlands, glades, grasslands, and closed woodlands.

A biological evaluation (BE) has been conducted for this project. The analysis including the direct, indirect, and cumulative effects on all listed, candidate or proposed species and critical habitat are summarized below. Determinations of “may affect, but is not likely to adversely affect” have been made for all federally listed, candidate, and proposed species and critical habitat in the BE.

A similar biological evaluation has been conducted for RFSS species. “No effect” or “may impact individuals but is not likely to cause a trend to federal listing or loss of viability” determinations have been made for each of the three alternatives in the RFSS BE.

These determinations are based upon the application of the protective measures in the project design criteria and Forest Plan standards and guidelines. In addition, evaluation of the control methods showed a relatively low environmental risk to the species from use of the manual, mechanical, biological, chemical, and cultural controls proposed in the alternatives.

Direct and Indirect Effects on Tumbling Creek cavesnail, Gray Bat and Indiana Bat

Federally listed species that occupy riparian, ponds and cave habitat consist of Indiana bat, gray bat, and Tumbling Creek cavesnail. Both gray bat and the Tumbling Creek cavesnail depend on caves throughout their life. Tumbling Creek cavesnail is documented in only one cave in the world. Indiana bat uses caves only during hibernation (approximately mid-September to early April in Missouri. In addition, Indiana and gray bats use riparian and pond habitats for drinking, foraging, and travel/migration.

Activities that impact caves, foraging, and drinking areas (ponds and riparian areas), migration habitat in the form of dead/dying trees, and roost trees will be analyzed in this section.

Direct and indirect effects to these species include direct contact with herbicide, human disturbance while working around occupied trees or caves, the removal of a potentially occupied tree, smoke impacts to occupied caves, and the remote chance of herbicide entering water over which bats may forage, including streams and upland ponds. Effects as a result of the implementation of Alternatives 1-3 are discussed below.

Alternative 1 – No Action

There would be no direct impact to Tumbling Creek cavesnail from implementation of Alternative 1 because the only known site for this species in the world is in a private cave outside the MTNF Proclamation Boundary. No invasive plants are impacting Tumbling Creek Cave and no activities would be implemented in the recharge area. The only indirect impact of not treating NNIP on MTNF would be if a massive infestation of NNIP altered the hydrology within the recharge area and caused more or less water flow, or changes in the timing of water flow in the cave stream. While possible, this is a highly unlikely scenario within the foreseeable future.

There is very little documentation of effects of NNIP on bats. Direct mortality of northern bats (Jones, 2010) has been documented in Canada and big brown bats (Hoffmeister, 2002) in Illinois as individuals have been caught in the pods of common burdock. Common burdock is an invasive plant with Velcro-like qualities, but it has not shown invasive tendencies in Missouri and is not on the list of non-native species of concern for the Mark Twain National Forest. This plant is considered invasive in two western states, Colorado and Wyoming. Because there is no documentation of burdock impacting bats in Missouri, the no action alternative would have no direct effects on the gray or Indiana bat.

One potential indirect effect Alternative 1 may have on both the Indiana and gray bat is the potential loss of or change in distribution or abundance of prey species within areas of suitable habitat if NNIP are left untreated. Primarily, these species may be indirectly affected if numbers, distribution, and/or abundance of aquatic or terrestrial prey species changes due to NNIP infestations. It has been documented in California that as plant community organization is modified by exotic species, delicate relationships between plants and animals are altered or eliminated (Lovich, 1997). If exotic species monocultures are allowed to form and persist, floral diversity will decrease, along with prey species diversity. Because most insects evolved with a variety of native plants, it is unknown to what degree these prey insects will be affected with the growing NNIP infestations and changes in flora across the MTNF. Because current documented NNIP infestations are relatively small in size, impacts are thought to be minimal. There may be localized impacts on aquatic and terrestrial insects. Until impacts are researched further, it is unknown to what degree these changes will have on the gray or Indiana bat population over the long term or if these species will simply adapt to foraging on different prey species based on changes in the floral makeup of the landscape. The diet of Indiana bats varies through time and across the geographic range of the species (Sparks et al., 2005). Murray and Kurta (2002) determined the Indiana bat has a flexible diet and is probably influenced by available foraging habitat and prey, and possibly by local, interspecific competition. Therefore, it is likely that at least for small areas, Indiana bats would be able to adjust feeding with little impact to survivability and reproduction. Since aquatic NNIP infestations on MTNF are also small, scattered, and localized, it is unlikely that aquatic insect distribution, composition, or amounts would change so much that would affect gray bat reproduction or survival for the foreseeable future.

In addition, the Indiana bat could be indirectly affected due to changes in roost tree suitability caused by NNIP, including the proliferation of those invasive plants with vine-like qualities that could inhibit the use of roost trees by the bat. Access to roost sites and the amount of sunlight reaching roosts may be impacted negatively by the presence of living or dead vines on the trunk of a suitable roost tree (Kurta and

Kennedy, 2002). Primary roosts usually receive direct sunlight for more than half the day. Access to the roost site must be unimpeded by vines or small branches (US Fish and Wildlife Service, 2007c). Invasive plants with these habits include but are not limited to kudzu, Japanese honeysuckle, air potato, bittersweet, and wintercreeper. These plants are known to climb mature trees, although most do not reach the canopy of mature trees. Kudzu is one example of an invasive plant known to smother entire groups of mature trees. If these invasive vine species continue to grow without any treatment, indirect effects may occur to the Indiana bat, although it will likely take several years to have a noticeable impact. Another indirect effect to both Indiana and gray bats would include the presence of NNIP, such as kudzu, at cave entrances. If this vine grew massive enough, it could alter airflow in and out of the cave, changing the suitability of the cave for bats. Vegetation at a cave entrance may also provide cover for predators, such as snakes, that could catch bats as they enter/exit a cave entrance. This scenario is highly unlikely to occur in the foreseeable future, as none of the known bat caves on MTNF have any evidence of NNIP at their entrances.

Alternative 2 – Proposed Action

1. Manual Methods – There would be no direct effects to either of the bat species if NNIP in or adjacent to rivers and streams were removed using manual methods. Manual removal of NNIP in upland areas would also have no direct effects to either of the bat species, particularly since none of the plants removed by this method would be large enough to provide suitable roost trees for Indiana bats.

Indirect effects may include very short-term and localized silting of the stream, river, or artificial ponds as particulates are stirred while walking through the aquatic environment. Manual removal of invasive plants adjacent to these areas is unlikely to have any measurable impact on the aquatic habitat (aquatic insect production) used by Indiana and gray bats due to the small size and scattered locations of the sites needing treatment. Although there may be a very small amount of soil disturbance adjacent to aquatic environments as weeds are pulled or dug out of the ground, these actions are so small that any effects would be considered insignificant and discountable. In addition, design criteria will stabilize soil to prevent off-site movement. There would be some indirect beneficial effects from manual NNIP treatment. Removing NNIP vines from suitable roost trees or NNIP from cave entrances would ensure that they are available for use by Indiana bats or gray bats (caves), if the bats choose to roost there.

There would be no direct impacts to Tumbling Creek cavesnail since all activities would take place outside the cave environment and several miles away. There are no documented NNIP in or at the mouth of Tumbling Creek Cave. However, there are documented NNIP in the recharge area. If these were pulled using manual methods, an extremely small amount of soil would be disturbed. This soil would have to move approximately three miles downstream over fully vegetated forest, woodland, and glades to reach the occupied cave. It is extremely unlikely this would occur. Therefore, no direct or indirect effects will occur to Tumbling Creek cavesnail.

2. Mechanical Methods – The only NNIP large enough to provide potential roosting for Indiana bats is the tree-of-heaven which may grow large enough to shelter male (but not maternity) Indiana bats as they roost. Using chainsaws to cut these trees has a slight potential for direct impact to a male bat if it was roosting in a tree being cut. Since Indiana bats use ephemeral roost trees, they have evolved mechanisms to locate and use alternate roost trees. If a roosting bat were in a NNIP tree being cut, the highest likelihood is that the bat would arouse and fly to an alternate roost tree, using little extra energy. The chances of a male bat not escaping a falling tree (and being hurt or killed) are so small that it is considered insignificant and discountable.

Again, the Tumbling Creek cavesnail is documented only on private land in one cave and no direct effects will occur to this species since all actions would take place outside the cave. No indirect effects to the Tumbling Creek cavesnail are anticipated. Grubbing, bush hogging, and other mechanical activities will have a very small chance of disturbing sediment within the recharge area that would reach Tumbling Creek Cave.

No disking will occur in the RMZ and WPZ. However, areas adjacent to documented bat occurrences could be treated using mechanical methods. Noise disturbance from equipment use could occur to gray or Indiana bats near cave entrances depending on the timing and location of mechanical treatments. In addition, noise disturbance could occur to Indiana bats if a roost is occupied in the area where mechanical treatment occurs. However, some Indiana bat roost trees, foraging areas, and caves on MTNF are located very near industrial sites that produce loud, fairly constant noise that does not seem to affect their use of those areas. Design criteria SW2 will mitigate potential sedimentation effects to aquatic insects used by Indiana and gray bats.

Implementation of standards and guidelines and the design criteria will greatly reduce the chance for soil movement into aquatic environments, and subsequently reduce the potential for any adverse impacts to insect prey abundance, distribution, or composition.

3. Cultural Methods - These methods would not be used in the aquatic system but could be used adjacent to rivers, streams, ponds, and upland areas. The hot foam system would only be used in areas easily accessible by vehicle, and both the hot foam system and weed torch would be used for relatively small infestations of NNIP. Because caves will not be impacted by use of the hot foam system and weed torch, no direct or indirect effects will occur to gray bat or Tumbling Creek cavesnail. Indiana bats would either be hibernating in caves or roosting in trees during use of this equipment. Indiana and gray bat could be physically disturbed from noise during use of this equipment if an area near an occupied roost tree was being treated, but these pieces of equipment are not expected to change roosting or foraging habitat in a manner that it would become unsuitable for the gray or Indiana bats.

If new hibernacula, maternity colony, or male roost trees are documented on the MTNF before project implementation occurs, consultation with the U.S. Fish and Wildlife Service would be re-initiated to designate areas of use, buffer zones, or determine needs for physical protective structures. Treatment of NNIP within those designated areas may be subject to additional limitations or requirements as a result of future consultation.

4. Chemical Methods - Appendix C at the end of this document shows all chemicals proposed for use and compares their characteristics. Two herbicides may be used to treat Eurasian water milfoil and curly pondweed in the aquatic environment. These include endothall and aquatic formulations of 2,4-D, glyphosate. The remainder of the chemicals (and those aquatic herbicides also labeled for terrestrial use) can be used in upland situations.

NNIP have been documented within the Tumbling Creek cavesnail recharge area. However, design criteria will protect the recharge area from concentrated, aquatic-labeled chemicals from reaching the cave. These chemicals would not only need to travel approximately three miles downstream to reach the cave, but they would also need to reach the cave in high enough concentrations to affect the cavesnail. These concentrations are not used in the field but could occur during an accidental spill. Mixing of chemicals would take place outside the recharge area, minimizing any potential of concentrated chemicals reaching the cave. With these precautions, the Tumbling Creek cavesnail will not be affected directly or indirectly by the use of chemicals on MTNF lands. Although not required, the Missouri Department of Transportation does not apply chemicals along Highway 160 within the recharge area (Alan Leary, Missouri Department of Transportation, pers. comm. 2008).

This proposal will also have no effect on actions that may occur at the mouth of or directly adjacent to Tumbling Creek cave because it is privately owned.

Indiana and gray bat are nocturnal and typically remain in roosts during the day (trees for Indiana bats and caves for gray bats). Therefore, there is little risk they would be directly contacted by herbicide spray streams applied during the day on the ground or onto ground or mid-level vegetation. Upon leaving day roosts, bats could contact foliage recently sprayed with herbicides. Again, because they are nocturnal, it is highly unlikely the herbicide would still be wet, but it is possible that bats might get some on their fur by contact with treated plants. Mammalian toxicity data in suggests that the potential for adverse toxicological impacts to bats from the proposed herbicides is low. Noise or human activity near roosts during application is unlikely to impact Indiana or gray bat. During roost monitoring activities using radio telemetry equipment on the Shawnee National Forest, Indiana bats remained in roosts when threatened by human activities on the ground. When human presence ceased, bats emerged from roost trees (Megan York-Harris, pers. observation). During hibernation, both species would remain in caves and would not be affected by the minor amounts and temporary nature of noise created with herbicide application. No direct effects to these species will occur.

Proper application of herbicides following the manufacturer label would ensure little potential for inadvertently killing the crowns of mature, live trees, therefore having no impact on the suitability or unsuitability of areas for foraging. In addition, Indiana bats may avoid roost trees choked with vines (Kurta and Kennedy, 2002). Any snags or dying trees with heavy NNIP in the form of vines (such as kudzu) would not be considered suitable roosts for the Indiana bat. Therefore, no potential roost trees will be affected as a result of chemical application to herbaceous or woody NNIP. The less dense understory that would result following the killing or removal of dense woody vegetation could improve foraging conditions until vegetation reestablishes.

The most likelihood of impacting the gray or Indiana bat would occur if chemical application affected 1) aquatic or terrestrial prey abundance or diversity or 2) if ingestion of contaminated prey or drinking water occurs. The proposed herbicides pose different levels of toxicity concerns to terrestrial and aquatic invertebrates. Prior to registration by the EPA, environmental risks must be evaluated on a variety of plant and animal species. Honey bees are typically used to indicate possible toxicity concerns for terrestrial invertebrates, while fish and/or Daphnia are used to assess effects to aquatic organisms.

All herbicides proposed for use in Alternative 2 have been tested on the honey bee, and testing showed that these herbicides are of low toxicity to the bee (LD50 dose of 10 µg/bee to 100 µg/bee) (LD50 = dose required to kill 50% of the test subjects). In fact, the U.S. EPA stated that sethoxydim, the herbicide that resulted in mortality to bees at the lowest dose (LD50 at 10 µg/bee), was practically non-toxic to honey bees (SERA 2001). Much higher doses of the other herbicides proposed for use in Alternative 2 would be needed to affect the honeybee (i.e., 100 µg/bee or greater doses). The fact that the herbicides are of a low toxicity, combined with small treatment areas, and the low likelihood that an Indiana or gray bat would be in the treatment area foraging at the time of treatment, these potential indirect effects are considered insignificant and would not likely rise to the level of take.

The herbicides proposed for use are considered to pose little risk of toxicity to aquatic invertebrates, with the exception of the ester form of Triclopyr and the surfactants used with the terrestrial form of glyphosate, which both can be highly toxic to aquatic organisms. Applying these materials following their label specifications and the design criteria, outlined earlier in this EIS, would reduce the risk of potential harm to aquatic life. In addition, application of these two materials in upland areas would likely occur on small portions of the project areas, and any small amounts reaching water sources would likely be diluted (in rivers or streams) and degraded by sunlight or microorganisms in ponds. Following design criteria, no triclopyr (ester formulation) or surfactants used with glyphosate (terrestrial version) will be applied within the WPZ or RMZ. In addition, mixing of chemicals will occur at least 100 feet from these areas to prevent concentrated chemicals from accidentally impacting special habitats. With the implementation of these design criteria, the chemicals proposed for use are not likely to harm aquatic life. For these reasons, this potential indirect effect on the Indiana and gray bat is considered insignificant and would not rise to the level of take.

The Indiana and gray bat could be indirectly exposed to herbicides through ingestion of contaminated insects or contaminated drinking water. The likelihood that individual bats would consume a terrestrial insect that had encountered herbicides is low, especially when one considers the small area that would be treated at any one time. It is assumed that direct contact or a high level of consumption of insect prey from herbicide-treated areas could potentially result in toxicological impacts. Again, toxicity data suggests that the potential for adverse toxicological impacts to bats from the proposed herbicides is low. Herbicides would be applied directly to targeted plants in a manner that minimizes the potential for drift (which could affect insects) or runoff that could contaminate drinking water sources. Should herbicides enter surface water used by Indiana bats for drinking, herbicide concentrations would quickly decline because of mixing and dilution, volatilization, and degradation by sunlight and microorganisms (van Es 1990). Research suggests there is low risk of bioaccumulation in the food chain from use of the herbicides proposed for use in Alternative 2.

Overall, while any adverse effects from Alternative 2 would be relatively small and temporary, any beneficial effects from eliminating NNIP from aquatic and terrestrial habitats would be long term. Protecting these habitats and allowing native vegetation to thrive will also benefit various prey species the Indiana and gray bat feed upon.

5. Biological Methods - No direct effects on gray bat, Indiana bat, or Tumbling Creek cavesnail are expected as a result of biological control of NNIP. There will also be no indirect effect to the Tumbling Creek cavesnail since this species is isolated to one cave and no NNIP are documented there. Although no competition has been documented between Indiana and gray bat prey species and bio-control agents, these indirect effects are possible. Therefore, it was determined the use of biological methods may affect but are not likely to adversely affect the Indiana and gray bat. All bio-control agents have proven to be effective with regard to reducing their host species. Therefore, beneficial effects may also occur based on the maintenance of native habitats in which these bat species have evolved.

Grazing is not permitted within the RMZ but could occur in other areas of the forest. A minimum 100-foot buffer must be in place along all perennial streams and rivers (Forest Plan, p. 2-3). As long as standards and guidelines are followed to protect waterways from erosion, grazing will have no effect on gray or Indiana bat or Tumbling Creek cavesnail.

Alternative 3 – No use of herbicides or root and seed head weevils

The same direct, indirect, and cumulative effects described for manual, mechanical, cultural, and biological control in Alternative 2 would apply to Alternative 3. Although the activities proposed in Alternative 3 may result in the reduction or eradication of some NNIP, it is not likely to treat those areas as effectively as Alternative 2 because some NNIP cannot be eradicated or controlled without the use of chemicals.

DIRECT AND INDIRECT EFFECTS ON HINES EMERALD DRAGONFLY AND FEN HABITAT INCLUDING CRITICAL HABITAT

Federally listed species that occupy fen habitats includes Hine's emerald dragonfly (HED). This species requires a unique and specialized habitat throughout its life cycle and is currently restricted to 12 sites on the MTNF. Additional searches may result in new locations for HED on the Forest in the future. Effects on these populations and potentially suitable habitat as a result of the implementation of Alternatives 1 -3 will be analyzed.

ALTERNATIVE 1 – NO ACTION

There is no evidence that any of the NNIP known to occur in MTNF fens would have any direct impacts on Hine’s emerald dragonflies. To date, site inspections of Hine’s emerald dragonfly fens with documented NNIP show that the plants are not impacting the habitat to the degree that it is changing the suitability of these areas for HED (Klaus Leidenfrost and Lynda Mills, U.S. Forest Service pers. comm. 2008).

Although direct effects on HED from NNIP infestations have not been identified, indirect effects on the Hine's emerald dragonfly and critical habitat could occur depending on the extent and intensity of infestations in relation to documented locations. These effects may include a potential loss of suitable habitat if native fen vegetation is eliminated or severely reduced by aggressive NNIP infestations. A variety NNIP are found in open situations and can survive in moist areas, which are the same habitat where Hine's emerald dragonfly is found. Those species surviving in wetland situations include sericea lespedeza, Japanese stiltgrass, Russian olive, bush honeysuckle, Japanese honeysuckle, and buckthorn. All these species have been found on the Mark Twain National Forest. However, none have been documented in inundated portion of the fen. These invasive plants are more likely to inhabit the edge of suitable Hine’s emerald dragonfly habitats.

The most likely indirect impact to Hine’s emerald dragonfly is a change in prey species and abundance (aquatic insects) if these areas are inhabited by invasive plants. NNIP can crowd out native vegetation, which is the substrate for native insect foraging. Therefore, prey distribution, abundance, and composition may change with a change in vegetation.

Hydrology may also be affected by changes from native vegetation to NNIP. Many invasive plants thrive in wet conditions. Potential effects of those species include crowding out native plants, increasing runoff, and altering nutrient cycles, all of which could adversely impact HED prey species and critical habitat. An example of this is tamarisk (a species occurring in the western U.S.) invasions, which have been documented to eliminate surface water in springs and streams (Cooperider 1995). None of the NNIP addressed in this analysis have been documented to impact hydrology in the same way. Changes in groundwater level or flow at a fen could reduce the number of crayfish burrows, limiting their availability to Hine's emerald dragonfly larvae during dry periods, and potentially affecting the survivability of larvae. The NNIP documented in MTNF fens to date are not generally found in inundated habitats but will likely remain on the edges of these habitats. It is possible with the implementation of Alternative 1; one or more fens on the MTNF could be completely transformed by a number of other invasive plant species found in open and wet habitats. However, this change would likely take a considerable amount of time because none of the NNIP documented at the fens seem to be changing hydrology or the plant community. Very little change to these habitats has been observed.

ALTERNATIVE 2 – PROPOSED ACTION

1. Manual Methods - If NNIP in fen systems were removed using these methods, direct effects to larvae may include trampling of crayfish burrows and possible direct killing of Hine’s emerald dragonfly larvae as a result of people walking through the habitat. Limiting the number of people involved in treatment, directing them to look for burrows prior to stepping, and possibly limiting their travel routes to specific “trails” may reduce the potential impact to crayfish burrows and HED larvae. This has been incorporated into design criteria (TES6). No direct effects will occur to adults since they would be able to fly away from any human activity in the fen and would be able to carry on their normal feeding, patrolling, and reproductive behaviors.

Indirect effects to critical habitat may include short-term and localized silting of the fen if bare soil is left unvegetated and changes in hydrology to the degree that some fens could become unsuitable. Native vegetation will be retained and soil disturbance will be limited as much as possible. If exposed soil results from NNIP control actions, exposed soils will be re-vegetated promptly to avoid re-colonization by NNIP. This is captured in design criteria SW2. Therefore, the likelihood of damaging the fen (and critical habitat) or altering fen hydrology as a result of manual methods is extremely low.

2. Mechanical Methods – No heavy equipment will be used in fens documented with Hine's emerald dragonflies per the design criteria and the Forest Plan Standard on page 2-13: "Prohibit all mechanical disturbances on springs, seeps, fens, sinkholes, and shrub swamps, regardless of size." Therefore, there will be no direct or indirect impacts to Hine's emerald dragonfly adults or larvae or critical habitat because mechanical methods will not be used. Again, Design Criteria SW2 will be in place to minimize siltation of the fen when working in the vicinity.

3. Cultural Methods – These methods may be used in fens. The weed torch and hot foam system will have no direct effect on Hine's emerald dragonfly adults or larvae because these are very specific to the target plant(s) and are easy to apply to specific plants. The majority of impacts from these methods will occur as a result of individuals moving through the fen itself to use this equipment. In this way, the same effects as those described for manual treatment could occur. The hot foam system could only be used in those fens accessible by vehicle. The Forest Plan does not allow mechanized equipment in the fens.

With the implementation of standards and guidelines in the Forest Plan, the cultural treatment of NNIP on or adjacent to fens is not likely to have direct or indirect effects on HED or critical habitat.

4. Chemical Methods – The one chemical most likely to kill sericea lespedeza, which has been documented in occupied fens, is fluroxypyr (specifically the herbicide Pasturegard). However, this is not labeled for use in the aquatic setting, so other chemicals would be used to treat sericea and other NNIP. These include endothall and aquatic formulations of 2,4-D, glyphosate, and triclopyr, as previously discussed in this EIS. While these herbicides may suppress NNIP, it may not completely kill them (See TES4 and TES5).

Direct effects could occur to adults and larvae if spray comes in direct contact with Hine's emerald dragonfly. This could occur as personnel spray chemicals along the edge of an occupied fen and Hine's emerald dragonfly comes into contact with direct spray or drift or if Hine's emerald dragonfly adults land on treated vegetation that has not dried. However, no herbicides will be used within the fen or in any connected drainage features (see TES4) unless directly applied using a wicking method, therefore the likelihood of Hine's emerald dragonflies coming into contact with sprayed herbicide is very low. In addition, indirect effects may occur if terrestrial or aquatic invertebrates are affected. This could negatively affect food prey or potentially suitable larval habitat in the form of crayfish burrows (if crayfish are impacted). As discussed previously, honeybees are typically used to indicate possible toxicity concerns for terrestrial invertebrates, while fish and/or Daphnia are used to assess effects to aquatic organisms.

When used according to label, all herbicides proposed for use in Alternative 2 have been tested on the honey bee, and testing showed that these herbicides are of low toxicity to the bee (LD50 dose of 10 µg/bee to 100 µg/bee) (LD50 = dose required to kill 50% of the test subjects). In fact, the U.S. EPA stated that sethoxydim, the herbicide that resulted in mortality to bees at the lowest dose (LD50 at 10 µg/bee), was practically non-toxic to honey bees (SERA 2001). Much higher doses of the other herbicides proposed for use in Alternative 2 would be needed to affect the honeybee (i.e., 100 µg/bee or greater doses). Applying aquatic labeled chemicals following label specifications and the design criteria, outlined earlier in this EIS, would reduce the risk of potential harm to aquatic life.

Application (by wicking) of the proposed chemicals would occur in occupied and unoccupied fens and most probable during the time that adults would be present (May through August). These are specialized habitats that are generally small in size with some water flow. Chemicals used in fen habitats would break down by sunlight and microorganisms. Although the SERA ecological risk assessments suggests that insects directly contacted by spray streams could be affected, it also says herbicide use in general poses little risk. If herbicide could be applied during the growing season but before adult HED emerge, there would be no potential for direct impact on adults. Most of the herbicides proposed for use under Alternative 2 are of low toxicity to aquatic invertebrate species and have been demonstrated to pose little toxicological risk to fish and wildlife when used at lower application rates typical for the Forest Service. Insects that contact wet foliage immediately after wicking could be affected. However, once the herbicide dries, it is unlikely that insects could be exposed to such high topical concentrations, even if they briefly land on treated foliage. Because of the limited acreage that would be sprayed with herbicides under Alternative 2, few insects would be directly contacted by the spray, and the overall impacts to the species should not lead to mortality.

5. Biological Methods – Biological control methods proposed to target NNIP plants can be found in Table 4. None of the insects/fungus proposed for release have been documented targeting sericea lespedeza (Dave Moore, U.S. Forest Service, pers. comm. 2008). Two types of impacts are possible with the release of biological control agents. The first is the possibility of biological control insects to compete with native insects (fed upon by Hine's emerald dragonfly) or to compete with Hine's emerald dragonfly for food and other resources. All these biological control insects are beetles or weevils in the Order Coleoptera or flies in the Order Diptera with distinctively different ecological niches than insects in the Orders Odonata (includes the dragonflies). Therefore, it is unlikely there would be direct competition between Hine's emerald dragonfly and the biological agents. Although no research documentation was found regarding the potential for competition between native and non-native (released) insects, this has not been identified as a threat to Hine's emerald dragonfly or a reason for listing of this species. It is very possible adult dragonflies could forage on released biological control insects, which may benefit this species in the short-term.

The other scenario includes the potential for biological control agents to feed upon not only the targeted plant, but also native plants. The likelihood of biological control agents to be released in fen habitats is low. Impacts to Hine's emerald dragonfly are considered insignificant and discountable given the life history of that species.

The use of biological control may affect but is not likely to adversely affect Hine's emerald dragonfly.

Grazing is not permitted in fen habitats (see Forest Plan page 2-20). Therefore, grazing is not proposed in fen habitats with Alternative 2. No direct or indirect effects would occur to Hine's emerald dragonfly adults or larvae, and no direct or indirect effects would occur to hydrology of the fens, water quality, or insect production.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

The same direct, indirect, and cumulative effects described for manual, mechanical, cultural, and biological control in Alternative 2 would apply to Alternative 3, though the minimal effects expected from herbicide application would be eliminated. Although the activities proposed in Alternative 3 may result in the reduction or eradication of some NNIP, it is not likely to treat those areas as effectively as Alternative 2 because some NNIP cannot be eradicated or controlled without the use of chemicals.

DIRECT AND INDIRECT EFFECTS ON THREATENED, ENDANGERED PLANT SPECIES

Threatened and endangered plants may be directly or indirectly impacted by the proposed methods of NNIP control. The three TE plant species are Mead's milkweed, Virginia sneezeweed, and running buffalo clover. As noted above, there is one known Mead's milkweed site on the Forest, located in a designated Wilderness Area. There is one known extant running buffalo clover site on the Forest and there are no known occurrences of Virginia sneezeweed on NFS lands. There are two Virginia sneezeweed sites located within the proclamation boundary of the Forest on private land.

ALTERNATIVE 1 – NO ACTION

As noted above, there is only one known location of Mead's milkweed and one known location of running buffalo clover on National Forest lands. There are known locations of Virginia Sneezeweed within the Proclamation boundary but none on National Forest lands.

Taking no action to control NNIP species would have no direct effects on the three TE plant species. Indirect effects to the species could occur if NNIP are left unchecked. Simberloff (2010) noted that invasive plants could impact ecosystems by overgrowing and shading out native plants, changing fire regimes, and modifying water or nutrient regimes.

ALTERNATIVE 2 – PROPOSED ACTION

1. Manual, mechanical, and cultural methods The three TE plants could be affected by manual methods if they are not properly identified and protected. Known populations of the plants will be protected with the implementation of the Project design criteria (see TES12) and Forest Plan Standards and Guidelines. Mowing sites where running buffalo clover or Virginia sneezeweed occur would not adversely affect the population if conducted after seed has set, as proposed in the project design criteria. Motorized tools or equipment is not being proposed in the wilderness and thus will not affect the one populations of Mead's milkweed on the Forest. There are currently no known populations of NNIP near the Mead's milkweed site or the running buffalo clover site; however this could change in the future. Pulling, digging up, or girdling NNIP species would not directly impact these species and could benefit the species by opening up the habitat for them. Grazing could adversely impact running buffalo clover as specified in the June 2009 biological opinion. This adverse effect is temporary and is minimized by the implementation of Project design criteria that only allow grazing or mowing after seed has set. Mowing and grazing could benefit the plant and the site if implemented this way. There are no known occurrences of Virginia sneezeweed on NFS lands, however there are several sites within the proclamation boundary and NNIP species occur near those sites, though there is no proposal to manage NNIP off NFS lands. The use of a weed torch, hot foam or smothering methods would be directly applied to individual NNIP plants and therefore would not impact TE plants.

Hierro and Callaway (2003) and Pearson and Callaway (2003) discuss allelopathic effects from controlling NNIP species. Allelopathic effects are the "negative effects of one plant on another one through the release of chemical compounds into the environment" (Hierro and Callaway 2003). The studies that they conducted or reviewed documented allelopathic responses from the management of several NNIP species including the following NNIP that the MTNF proposes to treat: *Cirsium arvense, Bromus tectorum, Sorghum halepense, Euphorbia esula*, and *Centaurea spp*. If these species occurred near the TE sites there could be a short-term negative effect on the site while removing the NNIP. Since there are no known NNIP populations near TE plant sites, adverse effects from allelopathy are not expected.

2. Chemical Methods. The three plants could be adversely affected by the use of herbicides if they were not properly identified and protected from direct application or from drift. Known populations of TE plants will be protected with the implementation of the project design criteria and Forest Plan Standards and Guidelines. In addition to this there are no known NNIP infestations around the running buffalo clover site, so the application of herbicides is not a concern here therefore the Mead's milkweed site will not be impacted. There are no known populations of Virginia sneezeweed on the Forest; however sites adjacent to NNIP infestations that may be treated with herbicides may occur. The implementation of project design criteria (TES 10 and 11) will be critical in protecting those populations from adverse effects.

3. Biological Control. Biological control agents are proposed for the control of spotted knapweed, musk thistle, leafy spurge, and Eurasian water milfoil. The agents proposed have been tested for host specificity. None of these agents have been developed to target Mead's milkweed, running buffalo clover, or Virginia sneezeweed or any very closely related (congeners) species.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

The same direct, indirect, and cumulative effects described for manual, mechanical, cultural, and biological control in Alternative 2 would apply to Alternative 3. Although the activities proposed in Alternative 3 may result in the reduction or eradication of some NNIP, it is not likely to treat those areas as effectively as Alternative 2 because some NNIP cannot be eradicated or controlled without the use of chemicals.

DIRECT AND INDIRECT EFFECTS ON REGIONAL FORESTER'S SENSITIVE SPECIES

Region 9 Regional Forester's Sensitive Species are discussed below. Region 9 and the Mark Twain National Forest are currently in the process on updating the 2008 RFSS list. The official updated RFSS list is expected to be approved by the Regional Forester in 2011. This evaluation includes all additional species added to the list.

The new RFSS list is comprised of 94 plants, and 8 mollusks, 4 insects, 2 amphibians, 5 mammals, 5 birds, 1 reptile, 10 fish, 8 invertebrates.

Two species were dropped from further consideration based on a lack of documented occurrences and an extremely limited amount of suitable habitat across MTNF lands. These two species are Bachman's sparrow and migrant Swainson's Warbler. Please reference the RFSS/SES NNIP Control Project Biological Evaluation for further information about these and state endangered species.

MAMMALS - Eastern Small-footed Bat, Little Brown Bat, Northern Myotis, Tri-colored Bat, Eastern Spotted Skunk

Alternative 1 (No Action): One Potential indirect effects Alternative 1 may have on the bats and Plain's spotted skunk include the potential loss of or change in distribution or abundance of prey species within areas of suitable habitat if NNIP are left untreated. Primarily, these species could be indirectly affected if numbers, distribution, and/or abundance of aquatic or terrestrial prey species changes due to NNIP infestations. Because current documented NNIP infestations are relatively small in size, impacts are thought to be minimal. There may be localized impacts on aquatic and terrestrial insects. Since aquatic NNIP infestations on MTNF are small, scattered, and localized, it is unlikely that aquatic insect or small mammal distribution, composition, or amounts would change so much as to affect these species' reproduction or survival for the foreseeable future. There is no evidence that the abundance of any NNIP would have direct, indirect, or cumulative impacts on those RFSS known or likely to use the project area. Although it makes sense to keep native habitats intact, the spread of invasive plant species in the 10-year timeframe in which this project may be implemented is not likely to change regional or range-wide populations of these two species to a degree that it can be measured.

Alternative 2 (Proposed Action): Direct effects to bats or Plains spotted skunk could occur if individuals were disturbed by noise, or crushed during heavy equipment operation (Pains spotted skunk). In addition, these species could be directly contacted with chemical, if contaminated water, insects, or other prey was ingested, or if habitat was changed in such a way that made it unsuitable for these species.

Indirect effects include changes in habitat suitability, amounts and quality of roosting habitat, changes in foraging habitat, and increased arthropod prey abundance (Eastern small-footed bat) or changes in small mammal prey (Plains spotted skunk).

The implementation of Alternative 2 may impact individuals but is not likely to cause a trend toward federal listing or loss of viability to the Eastern small-footed bat, little brown bat, tri-colored bat, and northern bat, and Plains spotted skunk. The treatment of habitats with the implementation of Alternative 2 is also not expected to cause negative cumulative impacts to these species.

Alternative 3 (No use of herbicides or root and seed head weevils): The same direct, indirect, and cumulative impacts as described in Alternative 2 apply to Alternative 3 with the exception of impacts from the use of herbicides.

BIRDS - Cerulean Warbler, American Peregrine Falcon, Bald Eagle, Migrant, Swainson's Warbler

Alternative 1 (No Action): The lack of NNIP treatment would have no direct effect on these RFSS birds. Indirectly, the increased understory density provided by some NNIP species, such as Japanese honeysuckle, could be beneficial for the Swainson's warbler. However, if Japanese honeysuckle became extremely thick, Swainson's warbler may move out of those areas. Areas of known infestation are small, and there is no evidence showing that any of the riparian species have been negatively affected by NNIP. Therefore, taking no action to control NNIP species would not likely have a substantial impact on either of these bird species.

Alternative 2 (Proposed Action): Potential direct effects include the destruction of Swainson's warbler nests, forcing these species to physically move from human disturbance, and/or killing or injuring of young or eggs during manual, mechanical, or cultural methods.

Indirect effects may include changes in habitat conditions (nesting, foraging, or cover) or prey species distribution or abundance. The data summarized in Appendix D of the RFSS/SES BE suggest that the herbicides proposed for use in terrestrial habitats are not highly toxic to avian (bird) receptors. However, the risk assessment for glyphosate concludes that small birds that consume insects from areas treated with the maximum application rate for an extended period of time could experience adverse effects (USDA Forest Service 2003a). Because cerulean warbler, and Swainson warbler prey includes insectivorous species, the use of chemicals in riparian habitats could negatively affect these two species if treated insects were consumed. Biological control agents could provide prey for the cerulean or Swainson's warbler. It is highly unlikely any of the control agents would compete with native insects to the point they would impact numbers or distribution of prey. Thus, the prey population and foraging ability of , cerulean and Swainson's warbler will not be negatively impacted as a result of biological control. It was determined the implementation of Alternatives 2 and 3 may affect individuals but is not likely to cause a trend toward federal listing or loss of viability to these species. No cumulative impacts will occur.

Alternative 3 (No use of herbicides or root and seed head weevils): The same direct, indirect, and cumulative effects as those described for Alternative 2 apply to Alternative 3 with the exception of impacts from the use of herbicide and fewer biological control agents.

AMPHIBIANS - Eastern Hellbender

Alternative 1 (No Action): One possible indirect effect Alternative 1 may have on Eastern hellbender is the potential loss or change in distribution or abundance of prey species within areas of suitable habitat if NNIP are left untreated. Primarily, this species may be indirectly affected if numbers, distribution, and/or abundance of aquatic or terrestrial prey species changes due to NNIP infestations. There is no evidence that the abundance of either of the two targeted aquatic NNIP is currently impacting Eastern hellbender populations because no aquatic NNIP have been documented near Eastern hellbender occurrences; thus impacts to Eastern hellbender are thought to be nil. In addition, no cumulative impacts will occur to Eastern hellbender.

Alternative 2 (Proposed Action): Direct effects in the form of trampling could occur. However, this would be unlikely because, no aquatic NNIP have been found near documented hellbender occurrences. Soil exposure from treatment of adjacent aquatic habitats could directly impact Eastern hellbender. The weevil would not be a prey species for Eastern hellbender unless it happened to fall off of a target plant into the water, where it could serve as food for this species. Because no aquatic NNIP are documented near Eastern hellbender, an impact to this species as a result of herbicide application in aquatic systems is unlikely.

Indirect effects may include short-term and localized silting of the stream or river as particulates are stirred while walking through the aquatic environment. There may be a small amount of soil disturbance adjacent to aquatic environments as weeds are pulled or dug out of the ground, but these actions are unlikely to have any measurable impact on aquatic prey base due to the small size and scattered locations of the sites needing treatment.

The implementation of Alternative 2 may impact individuals but is not likely to cause a trend toward federal listing or loss of viability to the Eastern hellbender. No cumulative impacts will occur.

Alternative 3 (No use of herbicides or root and seed head weevils): The same direct, indirect, and cumulative impacts as described in Alternative 2 apply to Alternative 3 with the exception of impacts from the use of herbicides.,

REPTILES - Alligator Snapping Turtle

Alternative 1 (No Action): There are no documented occurrences of alligator snapping turtle on National Forest lands although potentially suitable habitat occurs there. The only time this species moves far from the aquatic environment is during egg laying, where the female may move greater than 50 meters (~160 feet) from the water (Levine, 1994). Areas of known NNIP infestation are small, and there is no evidence showing that alligator snapping turtle has been negatively affected by NNIP. Therefore, taking no action to control NNIP species would not likely have an impact on alligator snapping turtle. No cumulative impacts will occur to this species.

Alternative 2 (Proposed Action): Direct effects could occur in the form of mortality if the turtle laid eggs or was in the process of moving to an area to lay eggs when mechanical treatment takes place. Individuals could be injured or killed or eggs could be crushed. Because none have been documented on the National Forest lands, direct impacts are unlikely.

Chemical control treatments in alligator snapping turtle habitats could result in direct exposure of alligator snapping turtles to herbicides if application occurs during the egg-laying period. Because no alligator snapping turtles have been documented on National Forest lands, it is unlikely that eggs, young, or adults would be exposed to chemicals. If undocumented occupied areas are treated, the physiology of reptiles is generally understood to be more similar to birds than fish or mammals. Reptiles are not commonly used as laboratory test subjects in toxicological studies. The SERA ecological risk assessments and summary of this information in Appendix G (of the RFSS/SES BE) generally suggest that these herbicides are not highly toxic to birds, and therefore are not expected to be highly toxic to reptiles.

Disking areas adjacent to rivers and streams used by the alligator snapping turtle will expose some soil making it available for movement into aquatic environments. This could impact the turtle indirectly by potentially affecting its prey base. Because the riparian corridor adjacent to aquatic environments remains moist throughout the majority of the year, vegetation would be present to provide a layer of filtering, minimizing the chances of soil movement into aquatic environments. No impact on aquatic invertebrates or water quality is expected.

Although no documented alligator snapping turtles are known to occur on the MTNF, suitable habitat exists and it is possible this species could be impacted, primarily during egg-laying activities. Therefore, it was determined Alternative 2 may impact individuals but is not likely to cause a trend toward federal listing or loss of viability. No cumulative impacts will occur to the alligator snapping turtle.

Alternative 3 (No use of herbicides or root and seed head weevils): The same direct, indirect, and cumulative impacts as described in Alternative 2 apply to Alternative 3 with the exception of impacts from the use of herbicides.

FISH - Blacknose Shiner, Blue Sucker, Bluestripe Darter, Crystal Darter, Eastern Slim Minnow, Longnose Darter, Ozark Shiner, Sabine Shiner, Stargazing Darter, Eastern Slim Minnow.

Alternative 1 (No Action): There is no evidence that the abundance of either of the two targeted aquatic NNIP has had any direct or indirect impacts on RFSS fish. Although indirect impacts to potentially suitable habitat could occur depending on the extent and intensity of infestations in relation to documented locations, this is not likely to happen within the lifespan of this project (ten years). No direct, indirect, or cumulative impacts are expected to occur with the implementation of Alternative 1.

Alternative 2 (Proposed Action): Direct effects include disturbance from human activities in occupied waters. Fish may be able to physically move to avoid operations during stream activities.

Disking areas adjacent to rivers and streams used for foraging will expose some soil making it available for movement into aquatic environments, which could impact aquatic species directly (adding siltation into the water) or indirectly (impacting prey base). Design criteria will mitigate potential effects to RFSS fish. The herbicides proposed for use are considered to pose little risk of toxicity to aquatic organisms, with the exception of the ester form of Triclopyr and the surfactants used with the terrestrial form of glyphosate, which both can be highly toxic to aquatic organisms (Appendix D in the RFSS BE). Following design criteria, no triclopyr (ester formulation) or surfactants used with glyphosate (terrestrial version) will be applied within the WPZ or RMZ or within 100 feet of lakes, ponds, sinkholes, fens, or wetlands.

Indirect effects may include short-term and localized silting of the stream or river as particulates are stirred while walking through the aquatic environment. There may be a small amount of soil disturbance adjacent to aquatic environments as weeds are pulled or dug out of the ground, but these actions are unlikely to have any measurable effect on aquatic species due to the small size and scattered locations of the sites needing treatment. There may be indirect beneficial effects to fish species, as the milfoil weevil could serve as food primarily for fish species. In addition, as Eurasian water milfoil is minimized, native aquatic plants will continue to grow and provide habitat for various prey species.

Overall, while any negative Impacts from Alternative 2 would be relatively small and temporary, any beneficial impacts from eliminating NNIP from aquatic habitats would be long term. Alternative 2 may impact individuals but is not likely to cause a trend toward federal listing or loss of viability to any RFSS fish population. No cumulative impacts are anticipated.

Alternative 3 (No use of herbicides or root and seed head weevils): The same direct, indirect, and cumulative impacts as described in Alternative 2 apply to Alternative 3 with the exception of impacts from the use of herbicides.

MOLLUSKS - Bluff Vertigo, Ouachita Kidneyshell, Purple Lilliput, Western Fanshell, Spectacle Case, Western Fanshell, Snuffbox, Northern Brokenray, Ouachita Kidneyshell, Stout Floater, Purple Lilliput, Bluff Vertigo

Alternative 1 (No Action): Whether or not the presence of aquatic NNIP would have enough impact to affect mussel reproduction or survival would depend on the size of the stream and the degree of infestation (Scott Faiman, Missouri Department of Conservation and Larry Furniss, U.S. Forest Service, pers. comm. 2008). Because most RFSS mussels are found in faster moving areas of rivers and streams (not the habitat in which curly pondweed and Eurasian water milfoil usually occur), indirect effects are unlikely. However, some mussels have been found in slower runs or pools (Scott Faiman, Missouri Department of Conservation, pers. comm. 2008). If any effects occur to mussel species due to lack of NNIP treatment, it would be on a very small scale.

One possible indirect effect Alternative 1 may have on these aquatic species is the potential loss of or change in distribution or abundance of prey species within areas of suitable habitat if NNIP are left untreated. Primarily, these species may be indirectly affected if numbers, distribution, and/or abundance of aquatic or terrestrial prey species changes due to NNIP infestations.

Alternative 2 (Proposed Action): Direct effects may include trampling and dislodgement of mussels from their substrate. However, most mussels have very tough shells that are not likely to be crushed while walking through a streambed or river. Disking areas adjacent to rivers and streams used for foraging will expose some soil making it available for movement into aquatic environments, which could impact aquatic species directly (adding siltation into the water) or indirectly (impacting prey base). Design criteria will mitigate potential effects to RFSS mussels. The herbicides proposed for use are considered to pose little risk of toxicity to aquatic organisms, with the exception of the ester form of Triclopyr and the surfactants used with the terrestrial form of glyphosate, which both can be highly toxic to aquatic organisms (Appendix D in the RFSS BE). Following design criteria, no triclopyr (ester formulation) or surfactants used with glyphosate (terrestrial version) will be applied within the WPZ or RMZ or within 100 feet of lakes, ponds, sinkholes, fens, or wetlands.

Indirect effects may include short-term and localized silting of the stream or river as particulates are stirred while walking through the aquatic environment.

There may be a small amount of soil disturbance adjacent to aquatic environments as weeds are pulled or dug out of the ground, but these actions are unlikely to have any measurable effect on aquatic species due to the small size and scattered locations of the sites needing treatment. There may be indirect beneficial effects to mussel species as Eurasian water milfoil is minimized, allowing native aquatic plants to grow and provide habitat for various host species.

Overall, while any negative impacts from Alternative 2 would be relatively small and temporary, any beneficial impacts from eliminating NNIP from aquatic habitats would be long term. Alternative 2 may impact individuals but is not likely to cause a trend toward federal listing or loss of viability to any RFSS mussel population. No cumulative impacts are anticipated.

Alternative 3 (No use of herbicides or root and seed head weevils): The same direct, indirect, and cumulative impacts as described in Alternative 2 apply to Alternative 3 with the exception of impacts from the use of herbicides.

INSECTS - A heptageniid mayfly, A Springtail or Espana Cave springtail, Greer Springs caddisfly or Micro Caddisfly, Westfall's snaketail,

Alternative 1 (No Action): Because Espana cave springtail occurs in caves, and there have been no documented NNIP in cave systems, effects on this species is not applicable to this alternative. There will be no direct impact on the remaining insects as a result of Alternative 1. Indirect effects could include changing habitat quality to the point the habitat was unsuitable or the potential loss of or change in distribution or abundance of prey species within areas of suitable habitat if NNIP are left untreated. Areas of known infestation are small, and there is no evidence showing that any of the insect species have been negatively affected by NNIP. Therefore, taking no action to control NNIP species would not likely have a substantial effect on these insects.

Alternative 2 (Proposed Action): Direct effects include possible disturbance to these species as a result of personnel moving through the habitats in which they occur (excluding cave environments). Disking areas adjacent to rivers and streams used for foraging will expose some soil making it available for movement into aquatic environments, which could impact aquatic species directly (adding siltation into the water). The herbicides proposed for use are considered to pose little risk of toxicity to aquatic organisms, with the exception of the ester form of Triclopyr and the surfactants used with the terrestrial form of glyphosate, which both can be highly toxic to aquatic organisms (Appendix D in the RFSS BE). Following design criteria, no triclopyr (ester formulation) or surfactants used with glyphosate (terrestrial version) will be applied within the WPZ or RMZ or within 100 feet of lakes, ponds, sinkholes, fens, or wetlands. This will minimize any direct impacts that may occur to these species, including the Espana Cave springtail.

Indirect effects may include short-term and localized silting of the stream or river as particulates are stirred while walking through the aquatic environment. Prey base could also be impacted as soil is disturbed adjacent to aquatic habitats.

Overall, while any negative Impacts from Alternative 2 would be relatively small and temporary, any beneficial impacts from eliminating NNIP from aquatic habitats would be long term. Alternative 2 may impact individuals but is not likely to cause a trend toward federal listing or loss of viability to any RFSS insect populations. No cumulative impacts are anticipated.

Alternative 3 (No use of herbicides or root and seed head weevils): The same direct, indirect, and cumulative impacts as described in Alternative 2 apply to Alternative 3 with the exception of impacts from the use of herbicides.

INVERTEBRATES - A Crayfish or Meek's crayfish, An Isopod, Big Creek Crayfish, Cavernicolous Harvestman, Central Missouri Cave Amphipod, Coldwater Crayfish, White River Midget Crayfish or William's crayfish

Alternative 1 (No Action): The isopod, cavernicolous harvestman, and central Missouri cave amphipod all occur in caves. Since there have been no documented NNIP in cave systems, effects on these three species are not applicable to this alternative. There will be no direct impact on the remaining insects as a result of Alternative 1. Indirect effects could include changing habitat quality to the point the habitat was unsuitable or the potential loss of or change in distribution or abundance of prey species within areas of suitable habitat if NNIP are left untreated. Areas of known infestation are small, and there is no evidence showing that any of the invertebrate species have been negatively affected by NNIP. Therefore, taking no action to control NNIP species would not likely have a substantial effect on these invertebrates.

Alternative 2 (Proposed Action): Direct effects include possible disturbance to these species as a result of personnel moving through the habitats in which they occur (excluding cave environments). Disking areas adjacent to rivers and streams used for foraging will expose some soil making it available for movement into aquatic environments, which could impact aquatic species directly (adding siltation into the water). The herbicides proposed for use are considered to pose little risk of toxicity to aquatic organisms, with the exception of the ester form of Triclopyr and the surfactants used with the terrestrial form of glyphosate, which both can be highly toxic to aquatic organisms (Appendix D in the RFSS BE). Following design criteria, no triclopyr (ester formulation) or surfactants used with glyphosate (terrestrial version) will be applied within the WPZ or RMZ or within 100 feet of lakes, ponds, sinkholes, fens, or wetlands. This will minimize any direct impacts that may occur to these species, including cave species. The use of biological control could provide additional prey for aquatic invertebrates. However, this is not likely to cause any measurable change in populations of aquatic invertebrates.

Indirect effects may include short-term and localized silting of the stream or river as particulates are stirred while walking through the aquatic environment. Prey base could also be impacted as soil is disturbed adjacent to aquatic habitats.

Overall, while any negative Impacts from Alternative 2 would be relatively small and temporary, any beneficial impacts from eliminating NNIP from aquatic habitats would be long term. Alternative 2 may impact individuals but is not likely to cause a trend toward federal listing or loss of viability to any RFSS insect populations. No cumulative impacts are anticipated.

Alternative 3 (No use of herbicides or root and seed head weevils): The same direct, indirect, and cumulative impacts as described in Alternative 2 apply to Alternative 3 with the exception of impacts from the use of herbicides.

Regional Forester Sensitive Species (Plants) Grouped by General Habitat

Cliff -2 species: Dirca decipiens, Goldie's Woodfern

Alternative 1 (No Action): No direct or immediate indirect effects. Lack of NNIP control could result in increased pressure on current populations or cause degradation of potential habitat for future establishment. No cumulative effects.

Alternative 2 (Proposed Action): While herbicide could have direct impacts to these species through drift and run-off, project design criteria reduce the risks, as does Forest Plan Direction.

It is unlikely that biological and mechanical controls will increase erosion to the point that it would degrade native habitat. Herbicides will have some drift that could impact non-target species; however, selective herbicides and application methods (Design Criteria) will minimize impacts. No cumulative effects.

Alternative 3 (No use of herbicides or root and seed head weevils): This alternative would have similar impacts as Alternative 2 for mechanical and biological controls, however since herbicides would not be used, the areas of soil disturbance from mechanical controls methods would increase. Forest Service guidelines on erosion control would prevent any negligible impacts to potential habitat.

Closed Woodland/Mesic Forest – 22 species: Large-leaf Aster, Ofer Hollow Reedgrass, Carex laxiflora, Carex timida, American Beakgrain, Log Fern, Small-flower Thorough-wort, Pale Avens, Large Whorled Pogonia, Butternut, Yellow Widelip Orchid, American ginseng, Carolina Phlox, Southern Rein Orchid, Pale Green Orchid, Crippled Cranefly, Ozark Spiderwort, Ozark Trillium, Yellowleaf Tinker's-weed, Softleaf Arrowwood, Northern Arrow-wood, Barren Strawberry

Alternative 1 (No Action): No direct or immediate indirect effects. Lack of NNIP control could result in increased pressure on current RFSS populations or cause degradation of potential habitat for future establishment. No cumulative effects.

Alternative 2 (Proposed Action): While herbicide could have direct impacts to these species through drift and run-off, project design criteria reduce the risks, as does Forest Plan Direction. In addition, RMZ and WPZ guidelines contained in the Forest Plan would further address the use of chemicals in these areas.

It is unlikely that biological and mechanical controls will increase erosion to the point that it would degrade native habitat. Herbicides will have some drift that could impact non-target species; however, selective herbicides and application methods (Design Criteria) will minimize impacts. No cumulative effects.

Alternative 3 (No use of herbicides or root and seed head weevils): This alternative would have similar impacts as Alternative 2 for mechanical and biological controls, however since herbicides would not be used, the areas of soil disturbance from mechanical controls methods would increase. Forest Service guidelines on erosion control would prevent any negligible impacts to potential habitat. No cumulative effects.

Glade/Prairie – 24 species: Purple False-foxglove, Bush's poppy mallow, Cherokee Sedge, Trelease's Larkspur, Open-ground Whitlow-grass, Yellow Coneflower, Wavy-leaf Purple-coneflower, Queen of the Prairie, Swamp Sunflower, Ringseed rush, Nieuwland's Blazing Star, Turk's Cap Lily, Baldwin's Milkvine, Narrowleaf Evening Primrose, Stemless Evening Primrose, Knotweed Leaf-flower, Harvey Beakrush, Orange Coneflower, Bush's Skullcap, Royal Catchfly, Gattinger's Goldenrod, Branched Noseburn, Prairie Venus' Looking-glass, Ozark Cornsalad

Alternative 1 (No Action): No direct or immediate indirect effects. Lack of NNIP control could result in increased pressure on current RFSS populations or cause degradation of potential habitat for future establishment. No cumulative effects.

Alternative 2 (Proposed Action): While herbicide could have direct impacts to these species through drift and run-off, project design criteria reduce the risks, as does Forest Plan Direction.

It is unlikely that biological and mechanical controls will increase erosion to the point that it would degrade native habitat. Herbicides will have some drift that could impact non-target species; however, selective herbicides and application methods (Design Criteria) will minimize impacts. There are no documented non-target effects to these species from the biological control agents proposed. No cumulative effects.

Alternative 3 (No use of herbicides or root and seed head weevils): This alternative would have similar impacts as Alternative 2 for mechanical and biological controls, however since herbicides would not be used, the areas of soil disturbance from mechanical controls methods would increase. Forest Service guidelines on erosion control would prevent any negligible impacts to potential habitat. No cumulative effects.

Open Woodland/Savannah – 7 species: Tradescant Aster, Small-head Aster, Carex timida, Parachute Sedge, Willdenow's Sedge, Ozark Chinquapin, Narrow-leaf Pink

Alternative 1 (No Action): No direct or immediate indirect effects. Lack of NNIP control could result in increased pressure on current RFSS populations or cause degradation of potential habitat for future establishment. No cumulative effects.

Alternative 2 (Proposed Action): While herbicide could have direct impacts to these species through drift and run-off, project design criteria reduce the risks, as does Forest Plan Direction.

It is unlikely that manual, mechanical, biological, or cultural controls will increase erosion to the point that it would degrade native habitat. Herbicides will have some drift that could impact non-target species. However, selective herbicides and application methods (Design Criteria) will minimize impacts. There are no documented non-target effects to these species from the biological control agents proposed. No cumulative effects.

Alternative 3 (No use of herbicides or root and seed head weevils): This alternative would have similar impacts as Alternative 2 for mechanical and biological controls, however since herbicides would not be used, the areas of soil disturbance from mechanical controls methods would increase. Forest Service guidelines on erosion control would prevent any negligible impacts to potential habitat. No cumulative effects.

Wetland/Springs/Seeps/Fens and Sinkholes – 38 species:, Wood Anemone, Marsh Bellflower, Water Sedge, Star Sedge, Buxbaum's Sedge, Fibrous-root Sedge, Cumberland Sedge, Epiphytic Sedge, Carex fissa, Giant Sedge, Graceful Sedge, Bicknell's Sedge, Dioecious Sedge, Straw Sedge, Tussock Sedge, Rigid Sedge, Fox Sedge, Hairyfruit Sedge, Pretty Sedge, Southern Cayaponia, Daggerleaf Spikerush, Closed Bottle Gentian, Featherfoil, Whorled Pennywort, Weak Rush, Small-fruit Seedbox, Bog Buckbean, Spotted Phlox, Yellow fringe Orchid, Small Green Woodland Orchid, Halberd-leaf Tearthumb, Nuttall's Oak, Gibbous Panic-grass, Canby Bulrush, Pale Manna Grass, Lesser Marsh St. Johnswort, Netted Chainfern, Slender Yelloweyed Grass

Alternative 1 (No Action): No direct or immediate indirect effects. Lack of NNIP control could result in increased pressure on current RFSS populations or cause degradation of potential habitat for future establishment. No cumulative effects.

Alternative 2 (Proposed Action): It is unlikely that biological and mechanical controls will increase erosion to the point that it would degrade native habitat. Herbicides will have some drift that could impact non-target species; however, selective herbicides and application methods (Design Criteria) will minimize impacts. There are no documented non-target effects to these species from the biological control agents proposed. No cumulative effects.

Alternative 3 (No use of herbicides or root and seed head weevils): This alternative would have similar impacts as Alternative 2 for mechanical and biological controls, however since herbicides would not be used, the areas of soil disturbance from mechanical controls methods would increase. Forest Service guidelines on erosion control would prevent any negligible impacts to potential habitat. No cumulative effects.

CUMULATIVE EFFECTS ON THREATENED, ENDANGERED & SENSITIVE SPECIES

Cumulative Effects on Gray Bat, Indiana Bat, and Tumbling Creek cavesnail

The geographic cumulative effects boundary for gray bat is the Mark Twain National Forest and perennial/intermittent waterways extending 45 miles outside of that boundary. This was determined because actions are limited to MTNF lands and the gray bat is known to forage 45 miles along river corridors and cross upland habitats to use ponds.

The Indiana bat geographic cumulative effects area is the MTNF plus a five mile boundary around the Proclamation Boundary. This was determined because this species has been documented foraging and roosting within five miles of roost sites and could occur across the MTNF in suitable habitats. The temporal boundary for this species is the ten year planning cycle. This timeframe allows documented NNIP to be treated and allows time for additional sites to be identified and treated.

The geographic cumulative effects area for Tumbling Creek cavesnail is the recharge area. This was determined because actions taking place outside this area would not have direct or indirect effects on this species.

The temporal boundary for all these species is the ten year planning cycle. This timeframe allows documented NNIP to be treated and allows time for additional sites to be identified and treated.

The abundance of NNIP in suitable habitats has not been identified as a factor responsible for the decline of gray or Indiana bat or Tumbling Creek cavesnail. Although negative effects have been documented in various situations with regard to rare species and NNIP in other areas of the United States, long term impacts on federal species as a result of NNIP infestations is not clearly understood. Although negative effects have been documented in various situations with regard to rare species and NNIP infestations in other areas of the United States, it is highly unlikely negative cumulative effects would occur to these species as a result of the no action alternative, due to the relatively small and scattered locations of known infestations at this time.

The implementation of Alternatives 2 and 3 are not expected to cause an incremental effect when combined with reasonably foreseeable future activities conducted on state or private lands. Areas proposed for treatment are relatively small and scattered across the Forest, encompassing primarily roadsides, old field habitats, or administrative sites, and design criteria will protect potentially suitable foraging and roosting habitat for gray and Indiana bat, as well as the recharge area for the Tumbling Creek cavesnail.

Past activities on National Forest lands, which have may have affected the gray and Indiana bat include timber harvest and illegal ATV use in riparian habitat (creating erosion/siltation, changing prey species abundance and diversity, and impacting water quality), human disturbance to caves, prescribed burning, and the construction of upland ponds. Present and reasonably foreseeable future actions are the same as those described in the aquatic cumulative effects section. Tumbling Creek cavesnail could have been impacted by past activities within the recharge area on National Forest lands, including timber harvesting, road building, or any other soil movement that was not mitigated to minimize erosion.

Cumulative effects from the implementation of Alternative 1 are difficult to assess because NNIP infestations are dynamic, exotic species are spread by humans and wildlife and continue to be documented, and not all outbreaks have been discovered in their entirety. Limited research exists regarding impacts of NNIP on wildlife. While some research shows species benefits from NNIP, other research shows negative impacts. Because native wildlife species evolved with native plants, it makes sense to keep native habitats intact. The lack of NNIP treatment is not likely to have a measurable cumulative effect on any of these species. Although most NNIP are very aggressive, thus far no impacts have been identified with regard to gray or Indiana bats or the Tumbling Creek cavesnail. The lack of NNIP treatment, combined with past, present, and reasonably foreseeable future actions on federal lands is not expected to contribute substantially to any measurable increase in cumulative degradation to these three species or their habitats.

The treatment of terrestrial and aquatic habitats with the implementation of Alternatives 2 or 3 is not expected to cause negative cumulative effects to the gray or Indiana bat or the Tumbling Creek cavesnail. Cumulative impacts to water quality, caves, terrestrial and aquatic prey, and roost trees are not anticipated because the scope of the proposed actions is extremely small. Although direct or indirect short-term and localized effects may occur to gray or Indiana bat in the form of sedimentation or human disturbance, there will be little to no incremental effect when combined with impacts of other past, present, and reasonably foreseeable future activities identified in Alternatives 1-3. This was determined because the treatment areas are relatively small and scattered, and the application of standards and guidelines in the Forest Plan will reduce or eliminate impacts to aquatic and other unique habitats. Design criteria will further protect aquatic and terrestrial habitats for specific actions proposed in this project. Chemicals applied to aquatic systems would degrade quickly in soil or water by natural processes. Consequently, actions proposed in Alternatives 1-3 are not expected to contribute substantially to any measurable increase in cumulative degradation of water quality, aquatic or terrestrial habitat (roost trees or foraging areas), terrestrial and aquatic prey diversity or abundance, or any impact to the Tumbling Creek cave.

Determination of effects in the Biological Evaluation states that the implementation of Alternative 1 will have no direct, indirect, or cumulative effect on Tumbling Creek cavesnail, Indiana bat, or gray bat. Alternatives 2 and 3 may affect but are not likely to adversely affect the Indiana bat, gray bat, and Tumbling Creek cavesnail. Although impacts to these species could happen as a result of changes in water quality (bats and Tumbling Creek cavesnail), human noise disturbance (bats), removal of potential roost trees (bats), and changes in prey abundance (bats) - design criteria will be implemented to minimize these impacts. Therefore, these effects are considered beneficial, insignificant, and discountable. The treatment of NNIP may also be beneficial for the gray and Indiana bat because it will help maintain native habitats and those native insects (prey species) that have evolved with native plants.

Mixing of chemicals will be done at least 100 feet away from wetlands, lakes, and streams to prevent accidental spills and concentrated chemicals from entering water used by rare species. Specifically to protect the Tumbling Creek cavesnail, only aquatic-labeled chemicals will be used within the Tumbling Creek cavesnail recharge area, and these will be mixed outside the recharge area. Consultation with the U.S. Fish and Wildlife Service will be reinitiated before treatment of newly discovered NNIP infestations occurs within that area. This consultation may be informal in nature. Fueling or oiling of mechanical equipment would occur at least 100 feet from aquatic habitats, caves, and mine openings. Exposed soils will be promptly re-vegetated so as to avoid re-colonization by NNIP and for soil stabilization. With the implementation of Standards and Guidelines in the Forest Plan, along with design criteria for Alternatives 2 and 3, the potential for “incidental take” of these species is nil.

Cumulative Effects on Hines Emerald Dragonfly and Fen Habitat

Six of the twelve occupied HED fens on MTNF lands have been documented with NNIP (and three additional unoccupied fens have documented NNIP). The geographic cumulative effects boundary for Hine's emerald dragonfly includes those 12 sites on the Mark Twain National Forest with documented occurrences, as well as approximately 3281 feet of buffer around each of those fens. This was determined because 1) NNIP may be documented in the future at occupied or unoccupied but suitable sites, 2) Hine's emerald dragonfly larvae are restricted to the fen itself, and 3) adults stay within about one kilometer of those fens to forage and defend territories from other males (O'Brien 2002). This distance is also expected to protect water quality that contributes to the hydrology of occupied and unoccupied fens. In addition, adults may use a complex of fens where they occur. The temporal boundary for this species is ten years. This is the life of the 2005 Forest Plan and the timeframe that allows for initial and subsequent treatments of NNIP infestations. This was determined because any discovered occurrences can be treated within that timeframe.

There are no State land within the Hine’s emerald dragonfly cumulative effects analysis area, but several fens with documented NNIP are located on or adjacent to private land. There are electric distribution lines, mowing, grazing, and herbicide application occurring within the cumulative effects boundary for Hine’s emerald dragonfly (larval sites) on private lands. Thus far, any actions on private land taking place within the cumulative effects boundary have not been known to impact hydrology, water quality, aquatic or terrestrial prey species, or populations of Hines emerald dragonflies in occupied or unoccupied fens (Jane Walker, former Researcher with Tyson Research Program, pers. comm. 2008), and these private activities are expected to remain the same in the foreseeable future. The proposed actions in Alternatives 1-3 are expected to have little or no direct or indirect impacts to individuals, habitat, or populations and therefore are not expected to cause an incremental effect when combined with reasonably foreseeable future activities conducted on private lands in the ESA cumulative effects area. There will be no cumulative effects to Hine’s emerald dragonfly as a result of Alternatives 1-3.

Past activities on National Forest lands that may have affected fen species and habitats include timber harvest (creating siltation, changing hydrology, and/or impacting water quality), human disturbance to fens, illegal ATV use in and around fens, and prescribed burning.

Other present and reasonably foreseeable future activities were discussed in the aquatic cumulative effects section and above in the Hine’s emerald dragonfly ESA cumulative effects section. In addition, there are mechanical activities and grazing occurring on MTNF lands within the cumulative effects analysis area. There are no pipeline utilities, herbicide application, or any other special use activities occurring within the cumulative effects boundary on MTNF lands.

For Alternative 1, the lack of NNIP treatment is not likely to have a measurable cumulative effect on Hine’s emerald dragonfly. Although most NNIP are very aggressive, thus far no negative impacts related to NNIP have been documented with regard to this species. The lack of NNIP treatment, combined with past, present, and reasonably foreseeable future actions on federal and non-federal lands is not expected to contribute substantially to any measurable increase in cumulative degradation to this species or its habitat within the 10 year timeframe identified in this analysis.

Cumulative impacts to water quality and terrestrial and aquatic prey are also not anticipated. Although direct or indirect short-term effects may occur to these species in the form of localized sedimentation or human disturbance, there will be little to no incremental effect when combined with impacts of other past, present, and reasonably foreseeable future activities identified in Alternatives 2 or 3. Standards and guidelines in the Forest Plan were created to protect aquatic habitats, including fens. In addition, design criteria will further protect fens for specific actions proposed in this project. Chemicals applied to aquatic systems would degrade quickly in soil or water by natural processes. Only herbicide labeled for use in or near water will be used in fens, and all chemicals will be mixed at least 100 feet from fen edges. Consequently, actions proposed in Alternatives 1-3 are not expected to contribute substantially to any measurable increase in cumulative degradation of water quality, or reduction of aquatic and terrestrial prey species, to Hine’s emerald dragonfly populations. Short-term beneficial effects may occur to Hine’s emerald dragonfly if biological control insects are fed upon by adults.

Determination of effects in the Biological Evaluation states that Alternative 1 will have no direct, indirect, or cumulative effect on the Hine’s emerald dragonfly. Alternatives 2 and 3 may affect but are not likely to adversely affect this species. This was determined primarily because individuals could be temporarily disturbed or displaced as work is conducted in fen habitats. The herbicides proposed for use are of a low toxicity, there are five occupied fens to be treated, and the majority of treated area would be confined to fen edges. These effects would be so small as to be insignificant and discountable. Other effects are beneficial as native plants are maintained, which will ensure native insects are available as prey species. Only herbicide labeled for use in or near water will be used in fens, and all chemicals will be mixed at least 100 feet from the fen. No mechanical disturbance to springs, seeps, fens, sinkholes, or shrub swamps will occur. Fueling or oiling of mechanical equipment would occur at least 100 feet from aquatic habitats, caves, and mine openings. Exposed soils will be promptly revegetated so as to avoid re-colonization by NNIP and for soil stabilization (SW2). Protecting specialized habitats and allowing native vegetation to thrive will benefit various prey species the Hine’s emerald dragonfly relies upon.

Cumulative Effects on Buffalo clover and Mead’s milkweed.

There are no NNIP sites at the known running buffalo clover and Mead’s milkweed site on the MTNF. There are no known Virginia sneezeweed sites on NFS lands, however sites occur adjacent to NFS lands within the proclamation boundary. The cumulative effects boundary for all three species includes the site themselves plus 25 feet around them. This is based on the distance drift from ATV boom sprayers is expected to go if all project design criteria are implemented. The temporal boundary is 10 years. This is the life of the Forest Plan and the timeframe that allows for initial and subsequent treatments of NNIP infestations.

There is no state land within the cumulative effects boundary for the three plant species. The two sites within the proclamation boundary are privately owned. One of the sites is located under electrical power lines and could be subject to mowing or herbicide use. The other site is located near a pond and could be subject to livestock grazing, herbicide or mowing. These uses will likely continue to occur in the foreseeable future.

The proposed actions in Alternatives 1 – 3 are expected to have little to no direct or indirect effects on the TE plants, except for mowing and grazing on running buffalo clover. These activities would adversely affect top growth for the year but will leave the root system intact and if implemented after seed has set, will leave the year's reproductive effort. Because the Forest will be implementing the project design criteria and there are no NNIP sites currently near the running buffalo clover site, no negative population effects to running buffalo clover will occur cumulatively. There are no Mead's milkweed sites within the cumulative effects boundary off MTNF lands.

Past activities on NFS lands that may have affected TE plant species include prescribed burning, timber harvest (including mechanical disturbance) and human recreation. The Forest has not taken any action to conserve the population of Mead's milkweed in the wilderness area and this population is likely to continue to decline unless management activities occur on the site (see USFWS 2005 – Programmatic Biological Opinion). The Potosi District conducted a prescribed burn that brought back the running buffalo clover because the burn improved habitat conditions at the site. Other Districts may decide to implement similar burns to try to stimulate re-population by running buffalo clover. Protection of habitat inhabited by Virginia sneezeweed and running buffalo clover (see Forest Plan standards and guidelines for RMZ's, WPZ, sinkholes, etc.) will protect the species as well.

There are no NNIP species currently impacting the extant TE plant populations on NFS lands. Alternative 1 could contribute to the spread of NNIP into TE plant sites. The lack of NNIP treatment combined with past, present and reasonably foreseeable future actions on federal and non-federal lands is not expected to contribute to significant population changes or habitat decline within the 10 year timeframe identified in this analysis. The implementation of Alternatives 2 and 3 could improve habitat conditions by reducing competition for resources by NNIP. There are no current NNIP infestations at any of the known TE plant sites. The treatments proposed combined with past, present, and reasonably foreseeable future activities is not likely to result in a significant change (decline) in TE plant populations or a decline in habitat quality.

Determination of effects in the Biological Evaluation states that implementation of Alternative 1 is not likely to adversely affect running buffalo clover or Virginia sneezeweed. As noted in the Programmatic Biological Opinion (USFWS 2005), taking no action to benefit Mead's milkweed is likely to adversely affect the species because it will continue to decline without intervention.

The implementation of Alternative 2 and 3 may affect but is not likely to adversely affect Mead's milkweed, running buffalo clover, and Virginia sneezeweed. This determination is based on the implementation of the protective measures outlined in the project design criteria and the Forest Plan Standards and Guidelines. Controlling NNIP populations that are close to TE plant sites (there are no NNIP sites at known TE sites) could prevent the invasion of TE sites as well.

THREATENED AND ENDANGERED AQUATIC SPECIES

AFFECTED ENVIRONMENT

Included in this group are five mussels, including Curtis' pearlymussel, pink mucket, scaleshell, spectaclecase, and snuffbox; and one amphibian, the Ozark Hellbender. These species spend their entire life in flowing water. Effects on these species, as well as rivers and streams in which they may occur, as a result of the implementation of Alternatives 1-3 will be analyzed.

There are two types of direct/indirect effects for this group of species. The first is the potential impact of treating aquatic NNIP, which may require activities within the waters that provide habitat for the aquatic TES. The second is the potential impact of treating terrestrial NNIP on lands adjacent to waters that provide habitat for aquatic TES.

DIRECT AND INDIRECT EFFECTS ON THREATENED AND ENDANGERED AQUATICS SPECIES

ALTERNATIVE 1 – NO ACTION

As noted in the table above, all aquatic TEPC species are found in riverine systems, not lakes, or ponds.

There are two aquatic NNIP targeted in this project, curly pondweed (Potamogeton crispus) and Eurasian water-milfoil (Myriophyllum spicatum). Both of these species have been documented from streams and flowing water, although these species generally inhabit areas of streams with little flow. Curly pondweed can survive in deep or shallow water (http://www.nwcb.wa.gov/weed_info/Potamogeton_crispus.html). Curly pondweed forms thick mats on the surface of the water, shading out vegetation below, while Eurasian water-milfoil consists of long underwater stems that branch and produce many whorled, finely divided leaves upon nearing the surface.

There is no evidence that either of these two aquatic NNIP would have any direct impacts on Ozark hellbenders or any of the five mussels. Indirect impacts could occur depending on the extent and intensity of infestations in relation to TEPC species locations. However, the current known locations of these aquatic NNIP are only in manmade impoundments on the Forest, not the streams that are occupied by hellbenders or mussels

Nonindigenous plants can colonize aquatic communities where they compete with and often displace native species, altering physical and biological functions of aquatic systems (USGS website, 2007). Indirect effects include a potential loss of habitat for host fish species (mussels), as well as changes in host fish species composition caused by changes in flow and substrate. Because fish hosts are generalist species, it is likely they will be able to adapt and persist in this changing aquatic system until NNIP infestations become much larger.

Whether or not the presence of aquatic NNIP would have enough impact to affect mussel reproduction or survival would depend on the size of the stream and the degree of infestation (Scott Faiman, Missouri Department of Conservation and Larry Furniss, U.S. Forest Service, pers. comm. 2008). If the infestation occurred at a major mussel bed, the potential impact could be significant. If infestations occur at locations remote from mussel beds, potential impacts, even to host fish, may be negligible.

Because most mussels are found in faster moving areas of rivers and streams, indirect effects for freshwater mussels are unlikely. This is especially true for spectaclecase, which occurs in deeper, faster flowing water. However, some mussels have been found in slower runs. Scaleshell has been found in pools (Scott Faiman, Missouri Department of Conservation, pers. comm. 2008), and snuffbox has been documented from ponds, although this is not the typical environment in which it is found (Roe, no date). The two aquatic NNIP are generally found in areas of the water that have less flow. If any effects occur to scaleshell, pink mucket, snuffbox, spectaclecase, or Curtis pearlymussel it would be on a very small scale.

Ozark hellbender is associated primarily with clear, rocky streams and rivers, usually where there are large rock shelters and bluffs (Jeff Briggler, Missouri Department of Conservation, pers. comm. 2008). The Ozark hellbender is found in those areas of the river that are free of sedimentation, which is the opposite of where NNIP have been documented. However, this species could be indirectly affected if distribution and abundance of prey species (primarily crayfish, fish, and aquatic invertebrates) changed due to NNIP infestations. Changes in flow and substrate due to infestations of aquatic NNIP could result in a potential loss of habitat for small fish and invertebrate prey species. However, due to the small areas of known infestations, and the large amount of habitat available in the lower Current, Eleven Point, and North Fork rivers, it is likely that these species will be able to adapt and persist. Therefore, any potential changes in suitable prey habitat are unlikely to have an impact on Ozark hellbender numbers and distribution over the long-term.

No literature was found with regard to invasive plant impacts on aquatic species native to Missouri. Some studies have shown positive relationships between rare species and invasive plants, while other studies show the opposite. For example, the green sea turtle, herbivorous and endangered world-wide, is able to adapt and benefit from exotic species. The red algae species Hypnea musciformis was introduced into the Hawaiian Islands in 1974 from its native Florida. Since its introduction, it has spread rapidly invading niches occupied by native species of Hypnea. Although the exotic algae are capable of inhibiting the growth of native species, some believe that the total productivity of certain Hawaiian reefs has increased due to the addition of H. musciformis. Green sea turtles utilize the exotic algae, which sometimes represents 99-100 percent of the seaweed mass found in their stomachs (Russell and Balazs, 1994).

ALTERNATIVE 2 – PROPOSED ACTION

Manual Methods – The only two aquatic NNIP that could be treated with these methods are curly pondweed and Eurasian water milfoil. These species are not currently known to occur on the Forest are not in the habitats for the hellbender and mussels and therefore treatment of those NNIP populations by manual methods will not affect those species. If new infestations of these aquatic NNIP were to occur in the occupied hellbender or mussel habitats, a potential exists to directly affect the species by trampling, disturbance, or sedimentation. These impacts could illicit responses that range from no response to avoidance, temporary displacement, injury or mortality (i.e., crushing individuals or egg masses). However, with implementation of the Design Criteria (see TES5) these impacts will be avoided.

Impacts to the hellbender and mussels could also occur from manual methods applied to non-aquatic NNIP adjacent to streams that are occupied by these species. There may be a small amount of soil disturbance adjacent to aquatic environments as weeds are pulled or dug out of the ground, but these actions are unlikely to have any measurable effect on mussels or the Ozark hellbender because of the small areas treated and the limited time of treatment. Application of Design Criteria will quickly stabilize soil to prevent off-site movement.

Mechanical Methods - No heavy equipment will be used in the aquatic environment. However, areas adjacent to documented mussel and Ozark hellbender occurrences could be treated using these methods. Bushogging would have no direct or indirect effect on these species since it does not disturb soil. Disking areas adjacent to rivers and streams will expose soil making it potentially available for movement into those aquatic environments. Increased siltation of the water may interfere with mussel filtration and may make it more difficult for hellbenders to find prey. This soil movement is expected to be minimal due to the small and scattered areas affected, the limited time of treatment, and the application of design criteria (See SW2) which will reduce potential effects to aquatic species.

Implementation of Forest Plan standards and guidelines will also greatly reduce the chance for soil movement into aquatic environments.

Cultural Methods - These methods would not be used directly in the aquatic system but could be used adjacent to rivers and streams (no grazing is allowed in the RMZ's). There will be no direct effects on aquatic organisms from these methods since they will not take place in stream. The hot foam system would only be used in areas easily accessible by vehicle. Both the hot foam system and weed torch would be used for relatively small infestations of NNIP, are easy to apply to specific target plants, and have little or no potential for material to runoff into the water. With the implementation of standards and guidelines in the Forest Plan, the treatment of NNIP adjacent to aquatic environments with cultural methods is not likely to have indirect effects on aquatic species

Chemical Methods - Four herbicides may be used to treat Eurasian water-milfoil and curly pondweed in the aquatic environment. These include endothall and aquatic formulations of 2,4-D, glyphosate, and triclopyr. There are NNIP occurrences within the watersheds that are occupied by hellbenders and the mussels. The two aquatic NNIP do not currently occur within habitats occupied by the hellbender or mussels. Design Criteria SW4 limits herbicide use only to man-made impoundments; therefore, herbicides will not be applied directly to suitable habitat for these species. Potential effects to aquatic wildlife species include herbicide moving downstream into occupied habitats, or if those chemicals are applied adjacent to aquatic settings and move on top of or through the soil into occupied aquatic habitats. In addition, indirect effects could occur if the food chain (primarily aquatic invertebrates) is affected, if the chemicals entered the water at toxic levels. Chemical control will not create soil erosion because it would kill but would not physically remove plants or their root systems. The dead plants will continue to stabilize the soil until new plants re-establish naturally unless manual methods accompany the herbicide treatment.

The proposed herbicides pose different levels of toxicity concerns to aquatic invertebrates. Prior to registration by the EPA, environmental risks must be evaluated on a variety of plant and animal species. Fish and/or Daphnia are used to assess effects to aquatic organisms.

The SERA ecological risk assessment suggests that proper use of herbicides, especially at standard rather than maximum rates, would pose little risk to aquatic receptors in nearby waterways, although the assessments focused primarily on fish rather than mussels.

Should herbicides enter surface water, their concentration would quickly decline because of mixing and dilution, volatilization, and degradation by sunlight and microorganisms (van Es 1990). Most of the herbicides proposed for use under Alternative 2 are of low toxicity to fish and aquatic invertebrate species and have been demonstrated to pose little toxicological risk to fish and wildlife when used at lower application rates typical for the Forest Service. However, some formulations of triclopyr (ester form) and some surfactants used with glyphosate (terrestrial form) are toxic to fish and aquatic invertebrates. Implementation of design criteria will prevent the ester formulation of triclopyr and surfactants used with the terrestrial form of glyphosate from being applied in aquatic settings. Mixing of other aquatic labeled chemicals will occur at least 100 feet from habitats where these aquatic species have been documented.

The potential toxicological effects of herbicides on amphibians such as the Ozark hellbender are not as well understood. Amphibians are not commonly used as laboratory test subjects in toxicological studies. One of the suspected causes of the widespread amphibian population declines is increased use of herbicides, including but not limited to herbicides (Bury et al. 2004). In addition, crayfish are the main food source, and chemicals proposed for application to the aquatic system are of low toxicity to aquatic invertebrates, so it is unlikely that there would be decreases in prey as a result of herbicide treatments. Ozark hellbender also is found in fast moving waters. Due to the limited extent of proposed treatment areas and ability for these aquatic-labeled herbicides to dilute in fast moving aquatic systems and degrade by sunlight and microorganisms, it is likely that the amount of herbicide Ozark hellbenders would be exposed to would be far below any of the levels of concern shown for fish and aquatic invertebrates. Although NNIP have been documented upstream from documented Ozark hellbender occurrences, design criteria would minimize the potential for exposure of concentrated aquatic-labeled herbicides to the this species because mixing of herbicides would occur at least 100 feet from rivers/streams with documented occurrences.

Due to the unknowns associated with this species, and the fact that this species has been proposed by the FWS to be listed as endangered, the Forest Service will implement additional measures to ensure there are no adverse impacts to Ozark hellbenders from herbicide treatments for NNIP control (See Design Criteria SW4).

A special concern when treating aquatic vegetation is to avoid rapid die-off of large quantities of vegetation. This could cause low dissolved oxygen levels as vegetation decomposes, suffocating mussels, as well as the fish hosts required for reproduction of the mussels. However, the implementation of design criteria SW4 would eliminate the use of herbicides in stream environments where these species occur.

Care would also be taken during applications adjacent to waterways to ensure that these herbicides and surfactants do not enter aquatic resources. Label direction would be followed to prevent or minimize any groundwater and surface water contamination from mobile chemicals. Herbicide treatment in riparian areas would follow label direction, specified design criteria, and Forest Plan direction to protect aquatic resources. When herbicides are used according to label specifications, no substantial long-term impacts to water quality, aquatic habitat, or aquatic species are expected.

Overall, while any adverse effects from Alternative 2 would be relatively small and temporary, any beneficial effects from eliminating NNIP from aquatic habitats would be long term. Protecting aquatic habitats and allowing native vegetation to thrive will also benefit various host species the five mussels rely upon.

Biological Methods - All biological control agents proposed for use have been tested and approved by APHIS. The only biological control agent proposed to target aquatic NNIP (Eurasian water milfoil) is the milfoil weevil (*Euhrychiopsis lecontei*). The milfoil weevil is a native species that may be used to control Eurasian water-milfoil within aquatic systems. Adult weevils live submersed and lay eggs on milfoil meristems. The larvae eat the meristem and bore down through the stem, consuming the cortex, and then pupate (metamorphose) lower on the stem (Sheldon and O'Bryan 1996). Development from egg to adult occurs in 18-30 days at summer temperatures (Newman et al. 1997, Mazzei et al. 1999). The consumption of meristem and stem mining by larvae are the two main effects of weevils on the plant, and this damage can suppress plant growth (Creed and Sheldon 1993, 1995), reduce root biomass and carbohydrate stores (Newman et al. 1996), and cause the plant to sink from the water column (Creed et al. 1992).

Sheldon and Creed (2003) examined effects of this weevil on six native North American water milfoils and determined that, although native water milfoil species can be impacted when *Euhrychiopsis lecontei* numbers are high, this insect will probably have little impact on the native species. They also determined in 1995 that native biological control agents offer potential advantages over classical biological control agents as they may have little impact on non-target native species that co-existed with the control agent.

Milfoil weevils will not come into any contact with Ozark hellbenders or any of the mussels. Because biological control agents target NNIP more slowly than chemical control, the risk of rapidly creating low dissolved oxygen levels is greatly reduced. The weevil would not be a prey species for the hellbender, nor would it be a parasite on the hellbender or mussels due to its life history. Therefore, aquatic biological control is not expected to have any direct or indirect effect on the aquatic TE species in question. In addition, there may be beneficial effects to mussel species as Eurasian water milfoil is minimized, allowing native aquatic plants to grow and provide habitat for various host species.

Grazing is not permitted within the RMZ. A minimum 100-foot buffer must be in place along all perennial streams and rivers (Forest Plan, p. 2-3).

No effects to aquatic TEPC species are expected as a result of biological control of terrestrial invasive species. The only potential effect would occur in large infested areas where many plants would be killed and erosion could occur. If large infestations were to be treated using biological control, design criteria would be implemented to stabilize soil and prevent the movement of soil into aquatic systems.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

The same direct and indirect effects described for manual, mechanical, cultural, and biological control in Alternative 2 would apply to Alternative 3. Although the activities proposed in Alternative 3 may result in the reduction or eradication of some NNIP, it is not likely to treat those areas as effectively as Alternative 2 because some NNIP (spotted knapweed) cannot be eradicated or controlled without the use of chemicals or the root weevil and seed head weevil.

CUMULATIVE EFFECTS ON THREATENED AND ENDANGERED AQUATIC SPECIES

The geographic cumulative effects boundary for aquatic species is their immediate habitat (perennial rivers and streams) along with the lands that comprise those watersheds. The geographic boundary for the Ozark hellbender includes the Eleven Point, lower Current, and North Fork of the White River; for the scaleshell, it includes the Gasconade and Meramec Rivers; for the spectaclecase, it includes the Big Piney, Gasconade, and Meramec; and for the pink mucket, it includes the Black River.

This boundary was determined because these purely aquatic species are limited to these habitats, dispersal of the species being analyzed is limited, and impacts to intermittent waterways could affect perennial habitat. The temporal boundary is 10 years, which is the life of the 2005 Forest Plan and the timeframe that allows for initial and subsequent treatments of NNIP infestations. This was determined because any discovered occurrences can be treated within that timeframe, and any measurable impacts would be apparent.

There is state and privately-owned land within the action area. Reasonably foreseeable future activities on private and state land that could occur in the future within the action area and result in impacts similar to those described for NNIS treatment on the MTNF include harvesting timber (soil disturbance) within the watersheds of rivers and streams that provide potentially suitable habitat for aquatic species, construction of dams, channelization, creation of new housing subdivisions and other structures (soil disturbance, erosion, water quality impacts, and habitat loss), application of a variety of herbicides that may or may not be used as labeled, human disturbance, prescribed burning, and road construction. These activities are likely to occur on other ownerships throughout the MTNF proclamation boundary.

In order to quantify the types of activities that might reasonably occur on state and private lands within the cumulative effects boundaries, several state agencies, organizations, and businesses were contacted. None was able to give complete information, and only a few were able to provide any quantification of the types of activities that occur on their ownerships. Therefore, for this analysis, several assumptions will have to be made.

The Missouri Department of Conservation, which is the largest owner of state lands in Missouri, has no quantified information with regard to types and amounts of herbicides sprayed across their lands in Missouri. Other activities this agency carries out which are difficult to quantify include bushogging, road construction and maintenance, and timber harvesting, as well as maintaining and operating campgrounds (with some herbicide use) across the state. The Missouri Department of Transportation (MoDOT) was able to quantify the amounts and types of herbicide used for each of the 29 counties. There were no herbicides reportedly used in 2007 by MoDOT labeled for use in aquatic systems. Quantity and types of terrestrial herbicides used by MoDOT in 2007 include 592 gallons of Roundup (glyphosate); 185 gallons of Krenite®S (FAS); 1153 gallons of 2,4-D; 1010 gallons of triclopyr. Other herbicides not proposed for use in this project were also applied by MoDOT in 2007. Annual training is provided to MoDOT employees and supervisors involved in the application of herbicide on Missouri roadsides. All herbicides are used according to label. Safety and environmental protection is a very important component of MoDOT operations (pers. comm. Justin Hills, MoDOT District 9 Roadside Manager). This agency also maintains road right-of-ways mechanically throughout the state of Missouri. Several other entities were contacted, including The Nature Conservancy, Department of Natural Resources, the Natural Resources Conservation Service, and Union Pacific Railroad. No consolidated information could be gathered from these agencies/organizations/businesses for the state of Missouri. We will assume for this analysis that these agencies/organizations/businesses, in addition to municipalities and all state, city, and county parks, and private landowners, are reasonably certain to continue managing lands as they have in the past, and that this management includes some methods to control NNIP on their lands, including the use of herbicides, which must be used according to label direction.

There are several electric and gas pipeline utility companies that manage lands across the 29 county area (see Appendices I and J, respectively), and those habitats affected are likely to include rivers and perennial and intermittent streams that could be occupied by the rare aquatic species discussed above. To represent electric companies, Ameren United Electric was contacted for information regarding maintenance of their powerlines. Some of these areas are maintained by mechanical means, but the majority of powerline right-of-ways on private and state lands are maintained using herbicides. Because utility companies are not required to maintain information with regard to types and amounts of herbicides sprayed in the state of Missouri, an overall picture of herbicide application by the utility companies operating in the cumulative effects area cannot be obtained. However, it is assumed that these companies only apply herbicides in areas for which they are labeled (as required by law).

Due to the difficulty of quantifying basic information and dividing this information into the specific watersheds defined for ESA cumulative effects for these aquatic species, we will assume that the type of effects in each watershed would be similar to the total effects within the entire 29 county area within which National Forest lands lie. The scope of effects would be less than the 29 counties in proportion to the amount of land within each watershed.

Although long-term impacts of uncontrolled NNIP infestations on aquatic federal/candidate species are not clearly understood, ESA cumulative effects are not anticipated as a result of Alternatives 1-3. Although negative effects have been documented in various situations with regard to rare species and NNIP infestations in other areas of the United States, it is highly unlikely negative cumulative effects would occur to aquatic federal/candidate species as a result of Alternative 1 for several reasons. The presence or abundance of NNIP in suitable habitats has not been identified as a factor responsible for the decline of any of the federal/candidate species in question. In addition, NNIP infestations near documented rare aquatic species are small and no obvious negative impacts have been seen that are affecting localized populations of any of the aquatic federal/candidate species in question.

In addition, the implementation of Alternatives 2 and 3 are not expected to cause an incremental effect when combined with reasonably foreseeable future activities conducted on state or private lands. Areas proposed for treatment on MTNF lands are relatively small, primarily encompassing roadsides, old field habitats, or administrative sites, and the application of design criteria will protect potentially suitable habitat for aquatic species by reducing the potential for impacts to occur. This is particularly true where herbicide application will occur within a riparian area or watercourse protection zone, or within the aquatic habitat itself.

Past activities on National Forest lands, which have may have affected aquatic species include timber harvest in riparian habitat and watersheds of the species considered (creating erosion/siltation), human disturbance to Ozark hellbenders from recreation on rivers, unintentional introduction of various aquatic plants or animals, and illegal ATV use in and around creeks and rivers. In addition, four of the same herbicides proposed for use in this document have been applied to MTNF lands since 1991. These include glyphosate, FAS, 2, 4-D, and triclopyr. These same activities are likely to have occurred on non-federal lands, along with planting, disking, bushogging, grazing, road construction, and maintenance, and other activities described in the ESA cumulative effects section. Much of the riparian land adjacent to streams and rivers within the Forest Service Proclamation boundaries is in private ownership, and activities there may have a disproportionate impact on aquatic species.

Several NNIS were intentionally introduced into the analysis area years ago (by various agencies) to improve wildlife habitat (multiflora rose, Japanese honeysuckle, autumn olive) or control erosion (purple crownvetch, sericea lespedeza). Over the years, these plants spread as seeds were dispersed by people, animals, wind, and water. Within the past few years, the extent of NNIP has increased tremendously in certain areas, primarily in open situations such as wildlife food plots, various right-of-ways, or where other disturbances have occurred.

A number of future projects are planned across the Mark Twain National Forest, which may have impacts to aquatic habitat and/or species. Some of the present and reasonably foreseeable future activities on National Forest land include timber harvest operations and reforestation, firewood gathering, site preparation, prescribed burning, pond construction and maintenance, transportation management, road closures, old growth designation, and herbicide application conducted by qualified herbicide applicators. Forest Plan standards and guidelines would be applied to these activities, reducing the potential for adverse impacts on aquatic habitats.

Herbicide application may also take place on National Forest lands in the future by Ameren United Electric, among other agencies, to maintain powerlines under Special Use Permits. This company applied for a special use permit to use herbicides across the MTNF, but permission has not been granted to any powerline company for herbicide use. See Appendices I and J for a list of powerline and pipeline companies that maintain utility lines across the 29-county area. All of these companies are under special use permit with the U.S. Forest Service to maintain lines on MTNF lands. Keep in mind not all acres that cross MTNF lands are under permit if lands are deeded easements to the company from the original landowner (Karen Mobley, U.S. Forest Service, pers. comm., 2008). As long as the company operates within the easement, then they are not under permit. For example, it is known that the ExxonMobil pipeline across Fredericktown maintains less than two miles across MTNF lands and is not listed on the spreadsheet because the easement was deeded to the company from the original landowner. The same situation exists with Southwest Power Administration, where approximately one mile is under easement. Various other activities that are reasonably certain to occur on other federal, private, and possibly state lands within the cumulative effects analysis area include various types of road maintenance and construction, such as the Highway 67 widening project which encompasses Butler, Wayne, and Madison counties (see http://www.modot.org/southeast/projects/corridors/documents/MapofPhases.pdf) and the Highway 60 project.

The Federal Energy Regulatory Commission is proposing to construct a transmission line across National Forest on the Poplar Bluff Ranger District to allow an increase in hydropower capacity at Wappapello Dam. This application would allow the applicant to have sole rights for three years to conduct feasibility studies and subsequently apply for a license to build and operate a hydro facility. This proposal may or may not be implemented as it is in the very early stages of planning. The Corps of Engineers is also involved with this project, and private lands would be affected as well.

Ft. Leonard Wood military base and the National Park Service were contacted to quantify herbicide use within the cumulative effects boundary. These are the two federal entities most likely to apply chemicals within the identified geographic cumulative effects boundary. Each entity was unable to provide accurate data with regard to types and amounts of chemical applied on their lands. The Missouri Army National Guard (MOARNG) in Butler County is under special use permit to conduct military operations on National Forest lands. Their 2007 report showed that the only chemicals applied that is proposed for use in Alternative 3 is glyphosate. Approximately 3.5 acres were treated to maintain training facilities. No waterways were treated with this application.

Cumulative effects from the implementation of Alternative 1 are difficult to assess because NNIP infestations are dynamic, exotic species are spread by humans and wildlife and continue to be documented, and not all outbreaks have been discovered in their entirety. Limited research exists regarding impacts of NNIP on wildlife. While some research shows species benefits from NNIP (Russell and Balazs, 1994), other research shows negative impacts (USGS website, 2007). Because native wildlife species evolved with native plants, it makes sense to keep native habitats intact. It is likely Eurasian water-milfoil and curly pondweed will continue to spread in various waterways, as history has shown, by both humans and wildlife. Aquatic invasive species in riverine systems may be somewhat easier to control because these species have a limited environment in which they occur, although it is easier for these species to get established by humans and wildlife. It is unknown how quickly or how far these aquatic invasive plants will take hold and spread in the ten year cumulative effects timeframe if left untreated, but it is unlikely cumulative impacts will occur to the aquatic species discussed above because 1) the mussels occur in those areas with swift water (which is not suitable for curly pondweed or Eurasian water-milfoil), and 2) no NNIP have been reported in areas with documented Ozark hellbenders. In addition, no specific information was found with regard to negative impacts of aquatic invasive plants on any of the TE or candidate aquatic wildlife species considered here.

The treatment of aquatic habitats with the implementation of Alternatives 2 or 3 is not expected to cause negative cumulative effects to rare aquatic species. Although short-term direct or indirect effects may occur to these species in the form of sedimentation or human disturbance (see aquatic species' analyses), there would be little to no incremental effect when combined with impacts of other past, present, and reasonably foreseeable future activities identified in Alternatives 2 and 3 for the following reasons:

Standards and guidelines in the Forest Plan protect aquatic habitats and will be applied with all treatments.

Implementation of design criteria will further protect aquatic habitats by minimizing the potential for impacts to occur as a result of specific actions proposed in this project.

Chemicals applied to aquatic systems would degrade quickly in soil or water by natural processes.

Consequently, actions proposed in Alternatives 1-3 are not expected to contribute substantially to any measurable increase in cumulative degradation of water quality, aquatic habitat, host species, or aquatic prey.

Determination of effects in the Biological Evaluation states that implementation of Alternatives 1-3 may affect but is not likely to adversely affect pink mucket, Ozark hellbender, spectaclecase, and scaleshell because Forest Plan Standards and Guidelines and Design Criteria have been developed to minimize or avoid adverse effects to these species. Any effects would be insignificant and discountable.

Beneficial effects from the elimination or reduction of NNIP (as proposed in Alternatives 2 and 3) from aquatic habitats would occur over the long term.

Protecting aquatic habitats and allowing native vegetation to thrive will also benefit various host species the three mussels rely upon.

RECREATION

AFFECTED ENVIRONMENT

Mark Twain National Forest provide settings for a variety of outdoor recreation activities such as camping, hunting, fishing, hiking, backpacking, horseback riding, use of motorized trails, canoeing, as well as picnicking, sightseeing, nature watching, and driving for pleasure. For management purposes, the forest recreation settings are divided into five classes of the Recreation Opportunity Spectrum (ROS), which is a planning tool used to define these settings and establish land allocations across the forest, with limits on the activities and facilities that can occur within those settings. These settings range from approximately 64,000 acres of Primitive (P) conditions in seven Congressionally designated wildernesses to 11,000 acres of Rural (R) in the more highly developed recreation areas that include paved camping spurs, flush toilets, showers, and picnic pavilions with electricity. The majority of the Forest is managed for Roaded Natural conditions (RN – 911,000 acres), Semi-Primitive Motorized (SPM – 323,000 acres) or Semi-Primitive Non-Motorized conditions (187,000). Within some parts of the Semi-Primitive and Roaded Natural areas, the Forest also provides small, rustic campgrounds that only accommodate a few people at a time, river accesses, scenic overlooks, trailheads, and parking. (Most of the above info is taken from the MTNF LMP FEIS, pg 305-306)

A variety of dispersed recreation experience opportunities are offered through management of approximately 750 miles of trails (including a 44 mile water trail, 90 miles of motorized trails, and almost 550 miles of trail managed for multiple uses including horses), and a road system that provides access to these opportunities. Approximately 99% of the 1.5 million acres of Mark Twain NF is open to dispersed recreation, and less than 1% is included in developed recreation areas. A key function of the developed recreation areas is to provide a base from which recreationists can enjoy the many dispersed recreation opportunities on the Forest. Some developed recreation areas provide facilities and activities for a complete recreational experience. (Most of the above info is taken from the MTNF LMP FEIS, pg 303)

Although almost the entire Mark Twain National Forest is open to recreational activities, and recreation takes place at least occasionally on most of the forest, the majority of those activities take place on lands that have one or more of three characteristics:

It is adjacent to and/or accessible from a transportation corridor. (That corridor may be a National Forest System road or trail, a road maintained and operated by another entity, or a floatable stream.)

It is within a designated and developed recreation site, where features have been constructed to accommodate or enhance recreation opportunities.

It is adjacent to and may provide access to a stream or a body of water that is large enough to support water-based recreational activities.

Dispersed recreation sites are typically located along roads and water bodies have developed due to repeated use by recreationists, though some are former developed sites that received little use and have had the facilities removed. Most of these sites are not formally inventoried, signed, or regularly monitored, and repeated use by recreationists can create conditions that are different from those found in lesser used areas of the forest. Dispersed camping during the hunting season would be considered high with camps occurring along many roads. Many hunter campsites have been used by the same hunting group year after year. Hunting is a major use of the general forest area during the fall months. Dispersed camping outside of the river zones increases substantially during deer and turkey hunting seasons; it is high throughout the summer along some of the rivers. Mushroom and berry picking and gathering of other forest products for consumptive and nonconsumptive use is popular throughout much of the forest. These activities are typically associated with roads for access reasons; however the activity usually occurs outside the immediate road right of way.

Congressionally designated management areas within the MTNF where recreation is a primary goal include the seven wildernesses and the 44-mile Eleven Point Scenic River, designated as part of the National Wild and Scenic River System. The river management corridor typically extends one quarter mile from the riverbank on each side of the designated segment. The presence of invasive species along the river corridor can detract from the aesthetic and recreational opportunities, and impact some of the values for the river has been designated, defined as the river's Outstandingly Remarkable Values. Primary uses of the river include floating in canoes and kayaks, boating with johnboats propelled by motors less than or equal to 25 horsepower, and fishing.

The following table displays the Outstandingly Remarkable Values for which the Eleven Point Scenic River is being managed:

Table 13 Comparison of Outstandingly Remarkable Values of the Eleven Point River, 1970s and 2002.

Outstandingly Remarkable Value (Rating)	1970s	2002
Scenic	Clear, clean, cold water ; steep to sheer slopes; Ozark landscapes	No change
Water features (A)	Floatable, variety of skill levels; springs; rapids	No change
Landforms (A)	Exposed bluffs; large boulders; gravel bars; ridges; floodplains	No change
Vegetation (A)	Oak-pine association; wildflowers; native warm-season grasses; seasonal changes (fall foliage, spring and summer wildflowers)	Management of habitat diversity for wildlife
Recreation	Floatable, variety of skill levels; peace; tranquility; remoteness	Ozark Trail section, Greer Springs Trail and interpretation
Span of attraction (A)	Frequent visitors from surrounding States; White's Creek Cave; Greer Springs	Irish Wilderness; Eleven Point River section of the Ozark Trail
Water sports (A)	Floatable; numerous access points; Class IV rapids	No change
Fishing (B)	Fishing, gigging and spearing	No change
Geology (A)	Mature karst topography; springs; caves; sinkholes	No change
Fish (A)	Rainbow trout; warm-water species	No change
Wildlife (A)	Large variety of species; restocking wild turkey	Threatened and endangered species (including bald eagles and Indiana bats); introduction of ruffed grouse
Prehistory (A)	Pigman mound; The Narrows	Section 106 consultation for projects
History (B)	Grist and lumber mill sites; logging operations, machinery, and structural remains; ferry sites	Section 106 consultation for projects; eligible National Historic Register sites
A = highest value; B = middle value; C = lowest value; T&E = threatened and endangered		

(MTNF - Forest Plan Analysis of Management Situation, Chapter 16)

Recreation Visitors and Their Activities: The forest's recreation market area covers a broad area encompassing southern Missouri and northern Arkansas, and western Kansas. The primary market area for the Forest includes seven urban areas that have a population of 100,000 to almost one million people within a 3-hour drive of one or more of the available recreation areas, including Saint Louis, Kansas City, Columbia and Springfield Missouri and Wichita Kansas. Major metropolitan areas such as Chicago, Cincinnati, Columbus, Memphis, Tulsa, Oklahoma City, and Little Rock are a leisurely day's drive away, and nearly one quarter of the nation's population lives within a day's drive of the Forest.

The National Visitor Use Monitoring (NVUM) program provides reliable information about recreation visitors to national forest system managed lands at the national, regional, and forest level. The study conducted on the Mark Twain National Forest in 2008 found that the forest serves a mostly local client base, with over 50% of the forest visitors traveling less than 25 miles to recreate on the forest, and another 25% traveling between 25 and 100 miles. Despite the local nature of the visiting population, there are only a modest number of frequent visitors. About 14 percent (1 of every seven) of all visits are made by people who visit more than 50 times per year. Over 45 percent of the visits are made by people who visit at most 5 times per year.

Most visits to the Mark Twain are day visits, with the average visit lasting less than 17 hours, and over half of the visits lasting less than 4 hours. Campground visits average 44 hours long, visits to developed day use areas average 2 hours, and visits to the undeveloped parts of the forest average 11 hours. Eighty percent of the visitors who spend the night away from home camp on the forest, as opposed to staying with friends or in other lodging. Approximately 14 percent of the visits involve recreating at more than one location on the forest. Average party size is 2.4 persons.

Most national forest visitors participate in several recreation activities during each visit, with almost half of the visiting population viewing scenery while on the forest and over 27 percent indicate that is their primary activity. Another popular activity on the Mark Twain is relaxing (36.7%), however for most that is not their primary activity. About 44% potentially use the trails, with almost one third of the visits involving hike/walk while on the forest, 10.5% riding motorized trails, 1.5% riding horses, and 1.2% riding bicycles. Over 25% of the visitors participated in viewing wildlife, over 20% participated in motorized or non-motorized water travel, and almost 20 percent camped. Almost 21 percent of the visits involve fishing with over 13 percent saying that is their primary activity, but while hunting made up only about 7% of the visits, it was the main activity for 59% of the persons who hunted on the forest. Almost 12% of the visits involved picnicking, but this was the primary activity for less than 12% of those visits.

Table 14 Recreation activities on the MTNF in 2008

Activities with Highest Participation	% Participating in Activity
Viewing Scenery	**46.4**
Hiking, motorized trail use, horseback or bicycle riding	**44**
Relaxing	**36.7**
Viewing Wildlife	**25.2**
Motorized or non-motorized water travel	**21.4**
Fishing	**20.5**
Camping, including backpacking	**19.6**
Picnicking	**11.9**

About 50% of the visitors reported using recreation facilities such as developed swimming or fishing sites or motorized trails during their forest visit.

Since people commonly help NNIP to spread, the areas where recreationists spend most of their time are the same areas where the recreation resource is most likely to impact the NNIP populations, and the areas where the NNIP populations are most likely to impact the recreating public. Recreation use on the forest is concentrated along our rivers and trails, and at the developed recreation facilities that serve use of those areas.

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ON RECREATION

ALTERNATIVE 1 – NO ACTION

Direct, Indirect, and Cumulative Effects: Under this alternative, the Forest Service would not implement the activities listed in the action alternatives considered for this project at this time. NNIP control on the MTNF would be based on other project decisions, past and future. Education, prevention and inventory efforts on the MTNF would continue.

Taking no action to control NNIP would increase the amount of manual and mechanical maintenance needed for some trails, campgrounds and day use areas to keep aggressive vegetation from encroaching into trail corridors and other open areas. Visitors may notice invasive plant populations when traveling through the forest by car, OHV, foot, pack stock or water craft. Taking no new NNIP control actions could eventually detract from the scenic beauty and diversity of recreation areas by allowing the development of NNIP monocultures. Dense stands of Eurasian water-milfoil (Logger's Lake) and curly pondweed (Council Bluff Lake) could interfere with boating and fishing in infested lakes. Alternative 1 also poses a potential indirect negative minor human health risk to some people who recreate in areas where tree-of-heaven and spotted knapweed occur.

ALTERNATIVE 2 - PROPOSED ACTION

Direct, Indirect, and Cumulative Effects: This alternative would implement an integrated program for the prevention, eradication, suppression, and reduction of existing and future NNIP infestations on the forest. These control methods would include various combinations of manual, mechanical, chemical, cultural, and biological treatments. Manual treatments, (pulling, grubbing, hand-cutting and digging with hand and hand power tools), would be the principle method for controlling small infestations. Mechanical methods, employing the use of a string trimmer, chain saw, brush saw, aquatic harvester, mower, tractor or other mechanical equipment, include mowing, tree/brush shearing, seeding, disking and plowing. Cultural control methods include the use grazing mammals, the Waipuna® hot foam system, scorching, smothering, and competition. Chemical treatments involve use of herbicide to control NNIP infestations where other methods would be cost-prohibitive, ineffective, or result in excessive soil disturbance or other resource damage. None of the herbicides proposed for use in this document are restricted use, all would be used according to manufacturer's label direction, and most would be directly applied to the target NNIP using spot treatments.

There should be no direct effects to recreational visitors on the MTNF from any NNIP control activities. NNIP treatments could indirectly affect the recreation experience of visitors to the MTNF. Visitors may notice invasive plant populations and treatments when traveling through the forest by car, OHV, foot, pack stock or water craft, and treated areas may not be visually pleasing to visitors. How noticeable the treatment is depends on the size of the invasive plant site being treated and the type of treatment being used. Eradicating invasive plants can make areas more desirable for recreation. Recreationists may appreciate a more natural landscape with intact native vegetation. While most people would consider the elimination of NNIP as aesthetically beneficial, others might prefer the aesthetic appearance of NNIP to that of natural vegetation. For example, honeysuckle shrubs form aesthetically attractive flowers in spring and red berries in fall. Some people could therefore consider the elimination of such species from the landscape as an aesthetically adverse impact. However, the long-term aesthetic benefits from replacing near monocultures of exotic plants with a diverse mix of native plant species may outweigh any short-term adverse effects.

Manual treatments may show signs of disturbed earth from digging or grubbing out root systems, with small patches of disturbed or exposed soil. Hand mechanical treatments may leave evidence of cut vegetation due to mowing, weed whipping, roadside brushing or lopping of individual plants. These effects are commonly seen by the visitor on and off the forest and are not expected to detract from their overall recreation experience. Removal of weeds plants that are blooming, producing seed, or scattering other plant debris outside the use corridor will further reduce these effects. Adverse effects would typically be of short duration, not more than one growing season. Visitors may be disturbed by the sight and sounds of hand crews or machinery as the treatment takes place.

Biocontrol measures would not be noticeable to the casual forest visitor.

Visitors that are concerned about exposure to herbicides may be more accepting of individual plant application methods, especially in high use areas. Chemical treatments would leave dead vegetation that would be noticeable for several days to several weeks, but individual plant treatments would be less noticeable than broadcast treatments. These effects would be of relatively short duration, typically one growing season, with some treatments in the fall when plants are brown and cured, so the treatment may not show visually.

All sites and areas that are treated with herbicides would be posted to inform forest visitors what herbicide was used, when it was applied and how long the herbicide would persist in the area before breaking down. Visitors may decide not to recreate in areas where herbicides have been applied. The greatest impact to visitors would be if they were not aware that herbicides had been applied in their destination recreation area prior to them arriving on the forest. Similar recreational opportunities exist across the forest so a visitor would be able to find a substitute place to recreate. This may provide an opportunity for forest visitors to explore new areas.

District recreation staff would help determine the best times and types of treatment, avoiding use of herbicides in heavily used areas on high use weekends.

The public would not be allowed in any areas during chemical (herbicide) treatment of NNIP, unless they were an approved contractor or volunteer. Closure times after application would last from 2 to 48 hours, depending upon the chemical used.

All disturbances created from removal of deep-rooted NNIP (or NNIP that are cut and sprayed) would either be filled or cut flush with the ground to reduce tripping hazards.

Notices would be posted along trails and in campgrounds and picnic areas treated with herbicides to ensure the public does not come in contact with chemical residue. Consistent with label instructions, some area might have to be temporarily closed (based on re-entry times) to the public to prevent people from contacting wet herbicide solutions on treated foliage, soil, or in lake water.

The effects to recreation associated with invasive plant treatments are short term. All recreation facilities, trails, and wilderness areas would not be treated at the same time, and the area to be treated in any one year will be a small percentage of the forest. Recreationists that are displaced due to their concern about herbicide exposure could recreate in alternate facilities or other areas. Similar recreation opportunities would be available that have not been treated with herbicides. Because herbicides have been and are being used extensively on non-Federal lands, most forest recreationists are aware of or familiar with some of the some of the benefits and risks associated with their use in a managed landscape. Many of the people who recreate in MTNF realize that this is a managed forest, and therefore would not be surprised to see that we are managing and treating the NNIP, even if they were not aware of the treatment timing or methods prior to their arrival on the forest. We anticipate that the proposed herbicide control methods would result in a substantial reduction or eradication of NNIP species within treated areas. Cumulative benefits include protecting native species, and creating a more natural landscape with intact native vegetation. Thus, there would be no contribution to significant cumulative adverse effects from this project on recreation resources.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

Direct, Indirect, and Cumulative Effects: This alternative would allow control of NNIP population by utilizing manual, mechanical, biological, or cultural treatment methods only. No use of herbicides or root or seed head weevils would be authorized.

The effects would be the same as noted for Alternative 2, except that no chemical treatments would occur in Alternative 3. There would be no need to close areas during most mechanical or manual treatments, or after these actions. The disturbance associated with manual and mechanical treatment would likely be increased.

WILDERNESS

AFFECTED ENVIRONMENT

Mark Twain National Forest includes 7 designated wilderness areas containing a total of 64,119 acres or 4.3 percent of the total Forest area. Gross acreages for the Forest wildernesses are: Bell Mountain (9,183 A), Devils Backbone (6,687 A), Hercules-Glades (12,414 A), Irish (16,506 A), Paddy Creek (7,075 A), Piney Creek (8,178 A), and Rockpile Mountain (4,283 A). The wildernesses are managed to maintain the areas' natural characteristics under Management Prescription 5.1 and the primitive Recreation Opportunity Spectrum class. The Wilderness Opportunity Spectrum (WOS) further stratifies each wilderness into units for application of different management actions to preserve a range of wilderness opportunities and options.

The results of natural occurrences such as storm damage and outbreaks of insects or disease are allowed as part of the natural cycle, unless there is a threat to resources on adjacent areas or continued use of the wilderness, but human caused intrusions are not allowed. A variety of non-native invasive plant (NNIP) species are mapped and inventoried in five of the seven wildernesses, and are known to be present in the other two. The establishment and spread of these species is the result of past human actions as well as natural forces. Lack of treatment on adjacent public and private lands, seed transport via recreation users along trail corridors (such as hiking and horseback-riding), and natural spread via wind and wildlife are all contributing factors. These plants have spread aggressively in other similar ecotypes. Sporadic hand-pulling of known populations of NNIP within the wildernesses over the last couple of years has not successfully resolved the problem – to control and reduce these populations will take a more focused effort. Where NNIP are introduced or spreading as a direct or indirect result of human influence, they adversely impact wilderness character, wilderness values, and the wilderness resource. There is an abundance of policy and direction prompting the Forest to take action to control the NNIP populations, and to be effective the action needs to occur within the wildernesses. Through analysis that the MTNF conducted as a part of their Minimum Requirements Decision Guide (MRDG), it was determined that the weeds are adversely affecting several aspects of wilderness character and other components. See the MRDG in project record for details.

A complete inventory of weed populations in Wilderness has not been conducted, but populations have been inventoried along travel corridors and in other areas of concentrated use in most of the Wildernesses, as a part of other management activities. A focused inventory of the travel corridors and areas of concentrated use was conducted in 2010 in Bell Mountain and Irish Wildernesses. These inventories identified 185 populations of NNIP within wilderness. Tables 1 and 2 show the total currently inventoried acreages of various non-native invasive species in wildernesses on the Forest.

Table 15 Currently inventoried acres of NNIP in Wilderness, by species

NNIS in Wilderness (priority)	Total Number of Mapped Populations	Total Area of Infestation, in Acres	Estimated Infested Acres
AIAL (tree of heaven)	2	1.4	.4
ALPE4 (garlic mustard)	1	.1	.1
CIAR4 (Canada thistle)	11	.1	.1
LECU (sericea lespedeza)	107	25.2	20.0
LOJA (Japanese honeysuckle)	3	12.6	6.7
MIVI (Japanese stiltgrass)	22	9.3	9.3
ROMU (multiflora rose)	39	4.0	4.0
TOTAL		52.7	40.6

Differences between total acreages in the two tables are the result of rounding.

Table 16 Current inventoried NNIP acres, by Wilderness

Wilderness Name	Total Area of Infestation, in Acres	Estimated. Infested Acres	Number of Mapped Populations	Number of NNIP Species Mapped in wilderness
Bell Mountain	6.0	6.0	60	2
Devils Backbone	4.1	0.5	6	1
Hercules Glades	2.5	1.0	4	1
Irish	39.6	33.7	113	7
Paddy Creek	0	0	Not mapped	Not mapped
Piney Creek	1.5	0.4	2	2
Rockpile Mountain	0	0	Not mapped	Not mapped
TOTAL	53.7	41.6	185	7

In general, Wilderness use on the Mark Twain is concentrated on weekends in spring and fall. Overall use has remained nearly constant for several years, though it may be increasing slightly. Hunting and hiking pressure seems to be about the same, but horseback riding in some Wildernesses has shown some increase.

To preserve the wilderness resource, alternatives were evaluated for their potential effects on the four **qualities of wilderness character**: untrammeled, natural, undeveloped, and outstanding opportunities for solitude or a primitive and unconfined type of recreation, and on other wilderness values through completion of a minimum requirements decision guide (MRDG) analysis. **Untrammeled** means the lack of management, manipulation, or hindrance of natural processes. The untrammeled quality of wilderness is the extent to which wilderness ecosystems remain free from modern human manipulation. **Natural** integrity is the extent to which long-term ecological processes are intact and operating. The **undeveloped** quality is a measure of how natural the environment appears and how free it is from any structures or developments. The **outstanding opportunities for solitude or a primitive and unconfined type of recreation** are subjective values defined as isolation from the sights, sounds, and presence of others, and the developments and activities of people. Primitive recreation opportunities are those that allow the recreationists to use backcountry skills, knowledge, and abilities that do not rely on developed facilities, mechanical transport or motorized equipment.

DIRECT, INDIRECT, AND CUMULATIVE EFFECT ON WILDERNESS

ALTERNATIVE 1 – NO ACTION

Direct, Indirect, and Cumulative Effects:

Wilderness Character

Untrammeled: The limited treatment of NNIP would not be effective in controlling the species and the long-term trammeling caused by the presence of invasives would continue. Additional short-term trammeling caused by this action would be negligible.

Undeveloped: No effect. There would be no effect on the undeveloped nature of wilderness character because there is no structural development or use of motorized equipment proposed.

Natural: The limited treatment of NNIP would not reduce or contain existing populations or prevent development of new ones in wilderness. Native ecosystems and natural communities would continue to be affected by the encroachment of non-native invasive species. Plant diversity would continue to decline.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation: The presence of non-native invasive species would adversely affect solitude by continuing a human-induced alteration of the environment.

Heritage and Cultural Resources: No effect. Planted flowers associated with some historical homesteads would not be treated or affected. Heritage sites will not be affected by pulling of NNIPs.

Maintaining Traditional Skills: No effect. This alternative does not affect maintenance of skills in the use of traditional tools (travel by foot and use of hand tools), because treatment is only incidental to other management actions.

Special Provisions: None.

Safety of Visitors, Personnel, and Contractors: No effect. This alternative does not affect safety, because treatment is only incidental to other management actions.

Economic and Time Constraints: Because of the limited resources involved in this alternative, it will not have a noticeable effect on short-term economic and time constraints. By not confining the NNIP populations or reducing their size while they are still relatively small, this alternative will greatly increase the resources needed to confine, reduce, control or eradicate the populations of NNIP in the future.

Additional Wilderness-Specific Comparison Criteria: None identified.

ALTERNATIVE 2 - PROPOSED ACTION

Direct, Indirect, and Cumulative Effects:

Wilderness Character

Untrammeled: Targeted non-native invasive species treatment using manual, non-motorized mechanical, chemical (herbicide) and/or biological methods would be a limited and short-term trammeling, but long-term the effective control the NNIP would enhance the untrammeled quality of wilderness. No grazing is proposed.

Undeveloped: No effect. There would be no effect on the undeveloped quality of wilderness character because there would be no structural development and no use of motorized equipment.

Natural: Effective NNIP treatment using integrated manual, non-motorized mechanical, chemical (herbicide) and/or biological methods would enhance the natural quality by restoring native vegetation and reducing the influence of non-native species on all components of the wilderness resource. Visitors would experience a more natural environment, closer to the intent of wilderness.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation: Encounters with NNIP treatment crews would reduce the solitude experienced by wilderness visitors. This is especially true for groups of persons that might be utilizing manual or mechanical methods any day of the week, as opposed to individuals or pairs of employees applying herbicides primarily on weekdays. As non-native invasive species populations decline, the frequency and amount of time required for treatment would be reduced. In the long term, this treatment will reduce the noticeable presence of NNIP, allowing restoration of native vegetation and enhancing the opportunities for solitude and a quality wilderness recreation experience.

Heritage and Cultural Resources: Use of herbicides or manual pulling, cutting or lopping of NNIP would not disturb heritage resources. Through coordination with archeologists prior to any digging or grubbing, adverse impacts to heritage resources will be avoided. Crews will not turn the soil over or remove it from the ground when digging/loosening plants at heritage sites. Herbicide use will reduce the need for grubbing, digging and soil disturbance, compared with alternative 3.

Maintaining Traditional Skills: This option helps maintain skills for use of traditional tools (travel by foot and use of non-motorized hand tools).

Special Provisions: None.

Safety of Visitors, Personnel, and Contractors: There is a risk to crews from working with herbicides and tools and from travel over rugged terrain. Effects on visitors can be minimized by publicizing or posting the areas and times of major treatment actions, as required by the Forest Plan, Job Hazard Analysis, Herbicide Use Proposal or other project design requirements; areas that have been treated with chemicals will be closed to visitors during and immediately after treatment, in accordance with standard re-entry times for those chemicals.

Economic and Time Constraints: More time would be involved in treating the NNIP than in Alternative 1, but much less time would be involved in treatment through implementing this alternative now, than with continuing with current actions in alternative 1 and later attempting to reach the treatment goals. Compared to Alternative 3, this alternative would involve less time. Herbicide applications take less time and labor to implement and they are more effective and longer lasting than manual/mechanical methods (with the first treatment generally killing the plant).

Additional Wilderness-specific Comparison Criteria: None identified.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

Direct, Indirect, and Cumulative Effects: This alternative would allow control of NNIP population by utilizing manual, non-motorized mechanical, biological, or cultural treatment methods only. No grazing or use of herbicides or root or seed head weevils would be authorized.

The effects would be the same as noted for Alternative 2, except that no chemical treatments would occur in Alternative 3. There would be no need to close areas during most mechanical or manual treatments, or after these actions. The disturbance associated with manual and mechanical treatment would likely be increased.

HERITAGE RESOURCES

AFFECTED ENVIRONMENT

The Mark Twain National Forest contains archaeological sites and historic structures that hold clues to America's past, covering human occupation from early prehistory to the more recent historic past. The prehistoric populations of Missouri utilized the Ozark landscape from as early as the Paleo-Indian period (~12,000 years ago), and archaeological sites dating from this period through the Mississippian period (1550 AD) are evident throughout the Forest. Historic sites on the MTNF date from the beginnings of European exploration in the late 18th century through the federal conservation programs of the early 20th century. Historic site types found on the Forest include habitations (homesteads and farms), industrial sites (mines, furnaces, mills, railroads, and trams), and civic/infrastructure sites (towns, schools, churches, roads, and bridges).

Cultural resources indicator species are relic populations of domestic/introduced (non-native) vegetation planted historically, for example at house sites or used as ground cover for burial sites. Examples of these indicator species include yucca, narcissus, daffodil, iris, forsythia, and others. Some cultural resources dating to the historic period may exhibit themselves on the surface solely through the presence of an indicator species. For example, an entire cemetery could escape detection and protection if an indicator species were eradicated prior to inventory; some burials are unmarked and only discernible by the presence of a domestic ground cover.

DIRECT AND INDIRECT EFFECTS OF HERITAGE RESOURCES

ALTERNATIVE 1 – NO ACTION

Direct, Indirect, and Cumulative Effects – No new NNIP control activities would occur in Alternative 1. Therefore, there would be no direct, indirect, or cumulative effects to heritage resources.

ALTERNATIVE 2 – PROPOSED ACTION

Direct, Indirect, and Cumulative Effects – Physical control methods that disturb the soil surface, such as hand-pulling or digging, can permanently disturb surface and subsurface archaeological resources occurring on or in the upper 6 to 12 inches of the soil profile. Particularly vulnerable are lithic and surface scatters of artifacts from prehistoric/historic periods and remnants of structural foundations. For this reason, the project design criteria specify that all annual treatments would be reviewed by a cultural resource specialist beforehand. Any needed protection measures would be implemented. If cultural resources are encountered during NNIP treatments, activity would be stopped pending further review by an archaeologist. Physical control methods that involve cutting of vegetation without disturbance of the soil surface, such as mowing, sawing, or use of a weed torch, would have little potential to disturb cultural resources and therefore may be performed at known cultural resource sites with Forest Archaeologist approval.

The use of herbicides or biological control agents has little potential to impact historical or archaeological resources. Application personnel or equipment could cause slight soil compaction or disturbance but would not substantially alter the spatial distribution of subsurface resources. Manual application of herbicides or releases of biological control agents would have negligible potential to disturb cultural resources (see project design criteria).

Chemical and biological control methods would have little potential to adversely disturb historical or archaeological resources. Physical control methods likewise pose little risk to cultural resources, given protection measures specified in the treatment protocol. Consequently, Alternative 2 is not expected to contribute substantially to an increase in cumulative disturbances to cultural resources.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

Direct, Indirect, and Cumulative Effects: This alternative would allow control of NNIP population by utilizing manual, mechanical, biological, or cultural treatment methods only. No use of herbicides or root or seed head weevils would be authorized.

The effects would be the same as noted for Alternative 2, except that no chemical treatments would occur in Alternative 3. There would be no need to close areas during most mechanical or manual treatments, or after these actions. The disturbance associated with manual and mechanical treatment would be increased. Consequently, Alternative 3 is not expected to contribute substantially to an increase in cumulative disturbances to cultural resources.

SOCIAL ECONOMICS

AFFECTED ENVIRONMENT

The relationship between the Mark Twain National Forest and local lifestyles and economies is interdependent and complex. Outdoor recreation, seven Wilderness areas, an exceptional wild and scenic river, and unique ecosystems all provide a stunning backdrop to many local communities that are growing at a fast pace.

Missouri has approximately 44,606,000 acres of land, and the Mark Twain National Forest administers approximately 1,498,000 of those acres. This constitutes approximately 3.4% of the total state land base. Almost 30% of the land in Missouri is forested, making it 20th in the nation in the amount of forested land. The MTNF manages 10% of the forested land and 84% of the publicly owned forested land in Missouri (Spencer, Roussopoulos, and Massengale 1992). Because of this, the MTNF contributes significantly to the rural economy of the Missouri Ozarks.

The Forest is composed of nine separate geographic units that span the state over 200 miles east to west and 175 miles north to south (Figure 1). Private land parcels are scattered throughout the Forest boundaries. On average, Federal ownership within the proclamation boundaries of the MTNF is about 49%, and ranges from a low of 24% on the Cedar Creek Unit to a high of 71% on the Eleven Point Ranger District.

DIRECT AND INDIRECT EFFECTS TO SOCIAL ECONOMICS

ALTERNATIVE 1 – NO ACTION

There would be no substantial direct or indirect effects on social conditions, local or regional employment, or revenue generated as a result of taking no action.

However, failure to effectively control the spread of NNIP species might result in a long-term detrimental economic impact as a result of a reduction in forage quality on rangelands and lower visitor-use in local recreational activities (with an associated loss of revenue). Additionally, failure to take appropriate action at this time, could result in an accelerated invasion of NNIP species, which might result in the need for more expensive control measures in the future.

No new NNIP control activities would occur with implementation of Alternative 1. Therefore, Alternative 1 would not require an expenditure of federal funds for treatment of NNIP beyond current levels. Small amounts of mechanical/manual control of NNIP occur on the MTNF annually. Because NNIP are considered one of the U. S. Forest Service's Four Threats, it is likely that additional funding could be allocated towards NNIP control in the future, and additional program areas, such as fire, timber, recreation, roads, and wildlife management, might fund future NNIP treatments. At present, the majority of the control work is accomplished by range personnel. Approximately $106,000 has been allocated annually to the Noxious Weeds program for the past three years. These funds cover employee salaries, small contracts, training, fuel, and purchase and maintenance of equipment.

ALTERNATIVE 2 AND 3

Because of the limited size of the proposed control activities, this alternative would result in little or no effect on local or regional social conditions such as increased traffic, overcrowding, school size, or crime rates. Similarly, the control methods would have no substantial direct or indirect effect on local or regional infrastructure requirements. Opportunities for local contract NNIP treatments would be created, although this would present only a minor increase in employment or revenue generation.

In general, costs depend on both the amount controlled (the reduction in the size of the invasion) and on the size of the invasion. In some cases, marginal control costs vary more with the size of the infestation as opposed to the method of control. For example, historical attempts to eradicate invasive species indicate that it may cost as much to remove the last 1–10% of an invasion as it does to control the initial 90–99% (Myers, Savoie, and van Randen, 1988).

All control methods require the expenditure of federal dollars, and funding would be needed for contracts, employee salaries, equipment and safety gear, and purchase of herbicides and biological control agents. Research and experience have indicated that integrated pest management is the most effective treatment method for the NNIP indicated (Tu et al. 2001). There would be a difference in the amount of funding needed for NNIP control on the MTNF based on the control methods, and infestation sizes, used to treat NNIP infestations. For example, chemical control is usually more cost-effective than mechanical control, and manual methods tend to be labor-intensive and therefore costly.

Over the long-term, costs associated with mechanical treatments are likely to become even higher because it is usually necessary to revisit the site and treat the NNIP for one or more years after the initial treatment, and additionally several times per year on some occasions. Often only one treatment with herbicides is needed to eradicate some NNIP (i.e., kudzu and woody shrubs), and mechanical control often requires more time and personnel than chemical control. For example, two people may be needed to cut and grub out tree-of-heaven, but one person could inject or apply herbicide to the individual tree in a fraction of the time it would take two people to remove the tree. Moreover, the cost-effectiveness of mechanical control for this example decreases in inverse proportion to the size of the infestation i.e. large infestations are cheaper (on a per-acres basis) to control than small infestations).

Biological control is likely to be more cost efficient than mechanical control, but biological agents can be used only on certain species. The cost of purchasing biological control agents and releasing them would likely be less than mechanical treatment of muck thistle, for example, and may be similar in cost-efficiency to chemical control.

For the Cane Ridge East project (Project #14903 - Decision Notice 3/18/2008) on the Poplar Bluff Ranger District, Mark Twain National Forest, an analysis was conducted by Megan York-Harris, District Wildlife Biologist, and Bill Paxton, Environmental Coordinator, regarding the use of a boiling sugar water system (Waipuna®) as an alternative to herbicides. It was determined that this system was not cost effective[7], labor intensive, and would require repeated treatments to achieve the Desired Condition. In addition, its utility is essentially restricted to more urban settings where water is easily accessible. Its use in wildland situations is therefore not considered feasible and cost-effective. Information regarding this method is contained in the Wildlife Biologist's files at the Poplar Bluff Ranger District office in Poplar Bluff, Missouri.

The use of livestock in some situations can reduce the cost efficiency of cultural treatments. Fresh water must be provided daily, fencing must be purchased, installed and checked periodically, and the animals must transported to and from the site. In the case of an experimental kudzu control project (using goats) on the Wayne National Forest, cost efficiency was estimated to be about three times more expensive than chemical control (USDA Forest Service 2007). Furthermore, after grazing and similar to mechanical control, the kudzu plants re-sprouted from underground roots within the same growing season.

[7] Waipuna does not sell direct to end users, but licenses and leases the equipment to approved operators (http://www.waipuna.com/licensee/general htm)

Table 17 Cost comparison of NNIP treatment methods

NNIP Type	Control Method	Examples of Applicable NNIP	Cost per Acre ($)[8]
Woody Shrubs and Large, non-woody Perennials	Manual	Autumn Olive, Multiflora Rose, Privets, Bush Honeysuckle	200-500
	Mechanical		30-60
	Chemical (foliar)†		15-30
	Chemical (cut-stump)		no data
	Biological		not applicable
	Cultural (Waipuna® Hot Foam)		7,0009
	Cultural (grazing)		not applicable
Annual Grasses	Manual	Stiltgrass, Cheatgrass	No Data
	Mechanical		15-45
	Chemical±		15-80
	Biological		not applicable
	Cultural (Waipuna® Hot Foam)		7,000
	Cultural (grazing)		6.50/head/month
Perennials or Biennials	Manual	Sericea Lespedeza, Spotted Knapweed, Garlic Mustard	No Data
	Mechanical		15-45
	Chemical		15-30
	Biological		No Data
	Cultural (Waipuna® Hot Foam)		7,000
	Cultural (grazing)		6.50/head/month
Dense, thicket-forming, climbing vines	Manual	Japanese Honeysuckle, Air Potato, Oriental bittersweet, Kudzu,	No Data
	Mechanical		2,560
	ChemicalŦ		250

[8] All costs, except the Waipuna® Hot Foam system and chemical treatment methods, are based on data provided by Mark Twain National Forest personnel and based on personal experience. Chemical costs are from other natural resource managers (†Tom Borgman 2007 work with amur honeysuckle (Wayne National Forest); ±based on herbicide application rate of 0.5-1ac/hour by a single backpack sprayer (SERA, 2003), Ŧ average treatment costs from Wayne National Forest

[9] Figure does not include $25,000 start up cost (Quarles 2001).

NNIP Type	Control Method	Examples of Applicable NNIP	Cost per Acre ($)[8]
	Biological	Wintergreen	not applicable
	Cultural (Waipuna® Hot Foam)		7,000
	Cultural (grazing)		not applicable
*Chemical cost considered negligible because application rates are low for these treatments.			

ENVIRONMENTAL JUSTICE

Executive Order 12898, titled Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, mandates that federal agencies take the appropriate steps to identify, address, and mitigate all disproportionately high and adverse impacts of federally funded projects on the health and socioeconomic condition of minority and low-income populations. Ethnic minorities are defined as African Americans, American Indian and Alaska Native, Asian, Hispanic or Latino, and Native Hawaiian and other Pacific Islanders. Low income persons are defined as people with incomes below the federal poverty level, which was defined in 2007 as $23,750.00 for a family of four (http://www.cms.hhs.gov/medicaideligibility/downloads/POV07ALL.pdf).

The action alternatives described in this EA are limited to Forest Service managed lands. Adverse impacts resulting from these activities would either not affect or would have limited short-term effects on residents bordering the Forest Service lands. The Mark Twain Forest Plan includes short-term closures during herbicide applications, should ensure that the proposed activities would have no impact on the health of minorities or low income individuals.

Cumulative Effects: According to the US Census Bureau, populations are increasing in most of the counties that contain the MTNF. Taking no action under the proposed project to control NNIP infestations would not directly result in any substantial increase or change in social conditions, local or regional employment, or revenue generated as a result of taking no action. As the impacts would be essentially negligible, there would be no direct incremental effect when combined with the socio-economic impacts of other past, present and reasonably foreseeable future activities. Consequently, there would be no appreciable contribution to a cumulative effect on either social or economic resources.

Because of the limited size of the proposed physical, chemical, and biological control activities, there would be little or no appreciable change or increase in employment, revenue, or social conditions as a result of Alternative 2. As the socio-economic effects would be essentially negligible, they would contribute little or no incremental effect when combined with the impacts of other past, present and reasonably foreseeable future activities. Consequently, there would also be no substantial contribution to cumulative effects on socio-economic resources.

HUMAN HEALTH AND SAFETY

AFFECTED ENVIRONMENT

Missouri is ranked 17th nationally among the states in population, with slightly less than 6,000,000 residents in 2000. The area has experienced a 19 percent increase in population from the 1990 census, but the counties that encompass the MTNF continue to be among the least densely populated areas of the state. Table 18 shows the regions ranked by their growth and average population density for the area. Greater detail on the socio-economic resources of the MTNF can be found in the Mark Twain National Forest Plan (USDA Forest Service 2003a) beginning on page 3-319.

Table 18 Unit population growth 2000 - 2010

Unit	2000 Population	2010 Population	Percent Growth	Average Population Density[1]
Ava-Cassville-Willow Springs (Stone, Barry, Ozark, Taney, Christian, Howell, Oregon)	216,520	257,900	+16%	47
Cedar Creek (Callaway, Boone)	176,220	206,974	+15%	123
Salem-Potosi (Crawford, Washington, Iron, Reynolds, Dent, Shannon)	67,764	111,775	+39%	19
Fredericktown (Iron, Madison, St. Genevieve, St. Francois, Bollinger,)	108,009	118,723	+9%	44
Doniphan-Eleven Point (Shannon, Oregon, Carter, Ripley)	38,118	39,687	+4%	14
Houston-Rolla (Wright, Laclede, Texas, Pulaski, Phelps)	154,461	177,824	+13%	44
Poplar Bluff (Wayne, Butler, Carter)	54,126	62,580	+14%	29

[1]Population Density is people per square mile.

Source: US Census Bureau, 2010 Quick Facts

DIRECT AND INDIRECT EFFECTS ON HUMAN HEALTH AND SAFETY

ALTERNATIVE 1 – NO ACTION

Direct and Indirect Effects: Taking no action to control NNIP infestations would not directly result in adverse impacts to human health and safety. One of the non-native invasive species that are known to occur on the MTNF, tree-of-heaven

(Ailanthus altissima), has been shown to have deleterious effects on human health. Bisognano et al. (2005) reported that exposure to the sap of tree-of-heaven has caused inflammation of the heart muscle in workers charged with clearing infested areas. These people experienced fever/chills, chest pain, and shortness of breath. Studies of its pollen also suggest it can cause rhinitis, conjunctivitis, and asthma (Ballero et al., 2003). Tree-of-heaven is known to occur on 988 acres of NFS lands, and is suspected to occur in more areas that have yet to be inventoried for NNIP. It is a prolific seeder, and at a minimum, the currently known infested areas are expected to expand in size under Alternative 1. Therefore, Alternative 1 poses a potential indirect negative human health risk to people who walk and work in areas where this plant grows.

In addition, Eurasian water-milfoil and curly pondweed are problematic weeds in Loggers Lake and Council Bluff Lake on the MTNF. Eurasian watermilfoil currently infests approximately 3 acres in Loggers Lake, and curly pondweed infests about 39 acres in Council Bluff lake. If left untreated, these infestations could continue to grow into denser stands that may affect recreational uses like swimming, boating, and fishing (Hoffman and Kearns,1997), and numerous drowning incidents have been blamed on dense mats of Eurasian water-milfoil which entangled swimmers (Washington Department of Ecology, 2004; Inland Empire Cooperative Weed Management Area, 2008). These infestations would also spread under this alternative.

Local residences use a variety of mechanical methods to control unwanted vegetation. Examples include bush-hogging to reduce woody encroachment, mowing of roadsides to maintain driver safety and aesthetics, and mowing of utility rights-of-ways to protect the integrity of powerlines.

These actions do not typically target NNIP, but instead they target any plant that is unwanted in a specific area of concern. Mechanical control methods mainly pose only minimal risk to human health and safety, but some injuries do occur to people who use mechanical equipment (e.g., scrapes, cuts, back strain, allergic reactions). Safety concerns during roadside mowing result in warning signs being placed along the roadways during mowing operations. It is expected that people will continue to employ these same mechanical activities on non-federal lands in the future at about the same level and intensity as occurs today.

On the MTNF, Forest Service employees and volunteers have hand-pulled spotted knapweed, musk thistle, garlic mustard and stiltgrass over the past 10 years. Employees have used tractor-mounted mowers to control invasive weeds in range allotments, skid-steers and tractors to either pull or grub-out autumn olive trees, and a tree-terminator on a skid-steer to also pull out autumn olive trees. No injuries have been reported during these activities. Recent Forest Service project decisions will enable the Forest Service to mechanically treat NNIP on approximately 200 acres of NFS lands, and the Forest Plan projects mechanical treatment of 2,000 acres for NNIP control over the next ten years.

As for cultural controls, cattle have been and will continue to be raised in the analysis area, but they are not typically used to control NNIP on non-federal lands. However, cattle are used on the MTNF to control sericea lespedeza. It is likely some injuries may have occurred during interactions with livestock, but the types and amounts are unknown.

No biological control agents have been used on the MTNF. In the near future, it is possible that some agents could be used to treat some NNIP on non-federal lands in the analysis area, but the risk to human health and safety from this is low. The Forest Plan projects the use of biological agents to control NNIP infestations on up to 100 acres of USFS lands in the next ten years.

Herbicides were first used after World War II, primarily to increase row crop production. Over the years, people have been exposed to herbicides to the level and intensity that they are today. There is no data repository to track herbicide use on non-Federal lands in Missouri, but some general knowledge is available, and some studies have been conducted. Many private landowners purchase pre-mixed sprays (i.e. Roundup©) from local retailers and apply them to their gardens, lawns, driveways, and patios. Although cropland is limited within the cumulative effects area, in most areas of cropland farmers apply herbicides seasonally to their row crops – usually with boom sprayers. There are large acreages of rangeland within the cumulative effects area, and on these lands herbicides are applied for control of NNIP such as spotted knapweed, Johnson grass and musk thistle. Herbicides are also used for fence line maintenance on rangelands. Highway departments (both State and County) apply herbicides to roadsides to promote safety and utility companies spray corridors to protect underground and surface transmission lines.

Currently, there are no drinking water or fish consumption advisories within the analysis areas related to herbicides. Herbicides will continue to be used on non-federal lands for these purposes in the foreseeable future and most likely at current levels and intensities.

In the past, herbicides were used to manage forest stands, range allotments, wildlife openings, rights-of-way, and roadsides. Some aquatic weed control was also practiced. However, the use of herbicides on the MTNF has significantly decreased from historic highs, and today consists of control in recreational areas and other administrative sites, fescue eradication for warm-season grass conversion, and some NNIP control related to project work.

In the act of a typical workday or visit to the MTNF, other human health and safety concerns may include cuts, scrapes, bruises, broken bones, heat/cold stress, allergic reactions, and insect bites.

ALTERNATIVE 2 – PROPOSED ACTION

Direct and Indirect Effects: Reduction of NNIP populations, whether by manual, mechanical, biological, cultural or chemical means, would result in improved forest health, which would have an indirect positive effect on human health and safety.

Mechanical control methods would pose little safety risk to workers or the public, if routine safety practices are observed. These safety practices address hazards related to operating mechanical equipment such as weed wrenches, brush cutters, tractors, and skid-steers, as well as exposure of workers to tree-of-heaven sap and other natural hazards such as poison ivy, stinging insects, or falling branches. Volunteer labor forces are provided the same safety orientation and training that is received by Forest Service employees.

None of the documentation on the six insects or fungus proposed for release shows any direct negative risks to human. However, an indirect link has been established between the use of gall flies (Urophora spp.) to control spotted knapweed and increased chances for Hantavirus (Pearson and Callaway, 2006). Over-wintering Urophora larvae have been shown to provide an increased winter food source for deer mice (Peromyscus spp.), which are a primary vector for Hantavirus. For this reason, the Urophora species originally included as bio-controls in the proposed action have been taken out of the integrated approach in Alternatives 2 and 3. More detail on this can be found in the project record.

As for grazing animals, there is always the chance an unsuspecting worker will receive a nip from a goat or sheep, but training is provided on how to work with livestock prior to the start of any project.

The herbicides proposed for use under Alternative 2 were selected largely for their low toxicity to humans and the environment. Federal law requires that before selling or distributing a herbicide in the United States, a person or company must obtain a registration, or license, from the U.S. Environmental Protection Agency. Before registering a new herbicide or new use for a registered herbicide, the U.S. Environmental Protection Agency must first ensure that the herbicide (including any adjuvants, surfactants, or other ingredients comprising the product contents), when used according to label directions, can be used with a reasonable certainty of no harm to human health and without posing unreasonable risks to the environment. To make such determinations, the U.S. Environmental Protection Agency requires scientific studies and tests from applicants (see the U.S. Environmental Protection Agency Regulating Website at: http://www.epa.gov/herbicides/regulating/index.htm#eval.

Table 19 Past, present, and foreseeable actions related to NNIP control and human health and safety.

	Past Manual/Mechanical	Present Manual/Mechanical	Foreseeable Future Manual Mechanical
Private Lands	Mowing, hand pulling, weed-eating, and some burning of grassy areas and ditches to control unwanted weeds; year-round, amount uncertain.	Mowing, hand pulling, weed-eating, and some burning of grassy areas and ditches to control unwanted weeds; year-round, amount uncertain.	Mowing, hand pulling, weed-eating, and some burning of grassy areas and ditches to control unwanted weeds; year-round, amount uncertain.
Utility Companies	Mowing and helicopter trimming on utility corridors to reduce woody vegetation; growing season – every 3-5 years. Amount uncertain.	Mowing and helicopter trimming on utility corridors to reduce woody vegetation; growing season – every 3-5 years. Amount uncertain.	Mowing and helicopter trimming on utility corridors to reduce woody vegetation; growing season – every 3-5 years. Amount uncertain.
Highway Departments	Mowing roadsides and weed-eating around signs and guardrails to maintain driver visibility; year-round. Amount uncertain.	Mowing roadsides and weed-eating around signs and guardrails to maintain driver visibility; year-round. Amount uncertain.	Mowing roadsides and weed-eating around signs and guardrails to maintain driver visibility; year-round. Amount uncertain.
State-owned Lands	Bush-hogging wildlife openings to maintain early successional habitat. Amount uncertain.	Bush-hogging wildlife openings to maintain early successional habitat. Amount uncertain.	Bush-hogging wildlife openings to maintain early successional habitat. Amount uncertain.
The Nature Conservancy Lands	Prescribed burning on approximately 2,000 acres annually.	Prescribed burning on approximately 2,000 acres annually.	Prescribed burning on approximately 2,000 acres annually.
Mark Twain National Forest	Avg. 900 acres annually since 1995. Mostly bushhogging in range allotments, but with some hand-pulling of spotted knapweed and musk thistle. Also skid-steer removal of autumn olive on Cedar Creek Unit.	Avg. 900 acres annually since 1995. Mostly bushhogging in range allotments, but with some hand-pulling of spotted knapweed and musk thistle. Also skid-steer removal of autumn olive on Cedar Creek Unit.	Avg. 900 acres annually to continue. Mostly bushhogging in range allotments, but with some hand-pulling of spotted knapweed and musk thistle. Also skid-steer removal of autumn olive on Cedar Creek Unit. Forest Plan projected treatment of 2,000 acres during the first decade.
	Past Chemical	Present Chemical	Foreseeable Future Chemical

	Past Manual/Mechanical	Present Manual/Mechanical	Foreseeable Future Manual Mechanical
Private Lands	Used for home landscaping improvements; annually, amount uncertain. Used to improve crop production; annually during growing season, amount uncertain (i.e., no records kept by agricultural agencies) – app. 542,500 acres of cropland in analysis area.	Used for home landscaping improvements; annually, amount uncertain. Used to improve crop production; annually during growing season, amount uncertain (i.e., no records kept by agricultural agencies) – app. 542,500 acres of cropland in analysis area.	Used for home landscaping improvements; annually, amount uncertain. Used to improve crop production; annually during growing season, amount uncertain (i.e., no records kept by agricultural agencies) – app. 542,500 acres of cropland in analysis area.
Utility Companies	Moderate use (mainly Ameren UE) to limit growth of vegetation under power lines and on other utility corridors; annually during growing season.	Moderate use (mainly Ameren UE) to limit growth of vegetation under power lines and on other utility corridors; annually during growing season.	Moderate use (mainly Ameren UE) to limit growth of vegetation under power lines and on other utility corridors; annually during growing season.
Highway Departments	Significant use along roadsides (e.g., around guardrails, steep areas); annually during growing season.	Significant use along roadsides (e.g., around guardrails, steep areas); annually during growing season.	Significant use along roadsides (e.g., around guardrails, steep areas); annually during growing season.
State-owned Lands	Chemical control was primarily used to control NNIP and other unwanted vegetation that compete with new seedlings, and to aid in conversion of fescue to warm season grasses. Amounts unknown.	Chemical control is primarily used to control NNIP and other unwanted vegetation that compete with new seedlings, and to aid in conversion of fescue to warm season grasses. Amounts unknown.	Chemical control wail be was primarily used to control NNIP and other unwanted vegetation that compete with new seedlings, and to aid in conversion of fescue to warm season grasses. Amounts unknown.
The Nature Conservancy Lands	Small amounts used for noxious weeds.	Small amounts used for noxious weeds.	Small amounts used for noxious weeds.
Mark Twain National Forest	Since 1991, the use of herbicides on the Mark Twain National Forest has declined from a high of 1087 acres treated in 2002 to 11 acres treated in 2007. Minimal amounts are used to treat poison ivy in campgrounds and picnic areas.	Since 1991, the use of herbicides on the Mark Twain National Forest has declined from a high of 1087 acres treated in 2002 to 11 acres treated in 2007. Minimal amounts are used to treat poison ivy in campgrounds and picnic areas.	Recent Forest Service project decisions will enable the Forest Service to use herbicides to treat NNIP on 168 acres of NFS lands (i.e., Crescent, Fairview, Middle River, and Shoal Creek Project Areas) and the Forest Plan allows for herbicide treatment of NNIP on 2,000 acres of NFS lands over the next ten years.

	Past Manual/Mechanical	Present Manual/Mechanical	Foreseeable Future Manual Mechanical
	Past Cultural	Present Cultural	Foreseeable Future Cultural
Private Lands	None	None	None
Utility Companies	None	None	None
Highway Departments	None	None	None
State-owned Lands	Small amounts of smothering for certain thistles. Competition used principally to replace fescue with warm-season grasses, although some NNIP are also controlled. Prescribed fire to control weeds is a secondary benefit to some areas.	Small amounts of smothering for certain thistles. Competition used principally to replace fescue with warm-season grasses, although some NNIP are also controlled. Prescribed fire to control weeds is a secondary benefit to some areas.	Small amounts of smothering for certain thistles. Competition used principally to replace fescue with warm-season grasses, although some NNIP are also controlled. Prescribed fire to control weeds is a secondary benefit to some areas.
The Nature Conservancy Lands	None	None	None
Mark Twain National Forest	Small amounts of smothering for certain thistles. Competition used principally to replace fescue with warm-season grasses, although some NNIP are also controlled. Prescribed fire to control weeds is a secondary benefit to some areas.	Small amounts of smothering for certain thistles. Competition used principally to replace fescue with warm-season grasses, although some NNIP are also controlled. Prescribed fire to control weeds is a secondary benefit to some areas.	Small amounts of smothering for certain thistles. Competition used principally to replace fescue with warm-season grasses, although some NNIP are also controlled. Prescribed fire to control weeds is a secondary benefit to some areas.

* The cumulative effects analysis area is defined as the 29 counties that contain the MTNF, and equals 12,200,784 acres.

Alternative 2 proposes to control NNIP on MTNF lands by a combination of manual, mechanical, biological, cultural, or chemical means. The physical and biological control methods will pose only a minimal risk on human health and safety, and they would contribute little or no incremental risk when combined with the impacts of similar past, present, or foreseeable future activities (Table 19).

Herbicides are not planned to be applied on all infestations on MTNF lands, but for this cumulative effects analysis we will assume they would be applied to all infestations. If that were the case, Alternative 2 would propose to use herbicides on 0.34 percent of the lands that comprise the cumulative effects analysis area. The choice of herbicides with lower toxicity, in combination with the safety precautions incorporated into the project, help minimize any health and safety concerns. Each of the herbicides proposed for use in this EA are considered safe when used in accordance with label direction. Because of this, there should be no measurable cumulative effects on human health and safety with implementation of Alternative 2.

Alternative 3 proposes to control NNIP on NFS lands by a combination of manual, mechanical, biological, and cultural means. These control methods will pose only a minimal risk to human health and safety. They would contribute little or no incremental risk when combined with the impacts of similar past, present, or foreseeable future activities (Table 19).

Table 20 Human health risk characterizations for herbicides proposed for use in Alternative 2.

Herbicide	Eye Risk	Inhalation Risk	Dermal Risk	Cancer Risk	Reproductive Effects
2,4-D (SERA 2006)	2,4-D acid and salts are severe eye irritants.	2,4-D and its salts and esters are of low acute toxicity on the basis of oral, dermal, and inhalation routes of exposure.	2,4-D and its salts and esters are of low acute toxicity on the basis of oral, dermal, and inhalation routes of exposure.	Neither the Science Advisory Board of the U.S. 3-17 EPA (U.S. EPA 1994) nor WHO (1996) concluded that 2,4-D, and its salts and esters are carcinogenic or mutagenic.	2,4-D does not cause effects on reproduction or fetal development in birds or mammals at exposures which do not cause toxic effects in maternal animals.
Aminopyralid (SERA 2007)	Classified by the U.S. EPA as Category IV, the minimal classification for eye irritants. Powder formulation may cause eye irritation	Based on these two acute inhalation toxicity studies, the U.S. EPA classified aminopyralid) as Category IV, the minimal classification for acute inhalation toxicity	Based on these two acute dermal toxicity studies, the U.S. EPA classified aminopyralid (both the acid and formulation) as Category IV, the minimal classification for acute dermal toxicity.	Based on the results of the mutagenicity screening studies and the in vivo bioassays, the U.S. EPA has concluded that aminopyralid is… “not likely” to be carcinogenic to humans (U.S. EPA/OPP-HED 2004, p. 13).	Based on studies and the U.S. EPA has concluded that: developmental and reproduction studies show that there is no evidence of increased qualitative or quantitative susceptibility of the fetuses to aminopyralid (U.S. EPA/OPP-HED 2005, p. 4)
Clopyralid (SERA 2004a)	Can cause persistent damage to eyes if direct contact occurs.	Harmful if inhaled. Does not readily volatize.	Transient dermalredness; does not cause skin sensitization.	No evidence of cancer with use of clopyralid.	Does not produce developmental effects at doses that do not produce maternal toxicity.
Dicamba (SERA 2004b)	Dicamba can cause mild and transient skin irritation as well as local eye and nasal irritation.	*Dicamba* is slightly toxic by *inhalation* exposure.	Dicamba can cause mild and transient skin irritation as well as local eye and nasal irritation.	There are no epidemiology studies or case reports that demonstrate or suggest that exposure to dicamba leads to cancer in humans.	At the highest application rates adverse reproductive effects are plausible.

Herbicide	Eye Risk	Inhalation Risk	Dermal Risk	Cancer Risk	Reproductive Effects
Endothall (Environmental Protection Agency 2005)	Endothall is very irritating to the eyes, skin, and mucous membranes	Endothall acid and the dipotassium salt of endothall are moderately toxic by oral ingestion and inhalation (toxicity category II).	Slightly toxic by dermal exposure (toxicity category III).	Endothall is considered not likely to be carcinogenic to humans. (Federal Register: Wednesday, August 16, 2006.)	The available developmental and reproductive toxicity data available do not indicate that there are pre- or post-natal toxicity concerns for infants and children. (Federal Register: September 24, 1997)
FAS (Environmental Protection Agency 1995)	Fosamine ammonium can irritate the eyes, causing discomfort, tearing, or blurring of vision.	Inhalation and ingestion of high doses may result in nonspecific discomfort, nausea, headache, or weakness.	Excessive contact with the skin may initially cause skin irritation with discomfort or rash.	Based on studies, no evidence of cancer risk.	Adverse reproductive effects have not been noted.
Fluroxypyr (Environmental Protection Agency 1998b)	Mild eye irritation resolved within 24 hours in 2 rabbits and within 48 hours in 1 rabbit; Toxicity Category III.	Fluroxypyr has moderate acute toxicity by the inhalation route. (Federal Register: December 28, 2007)	In a 21-day dermal study in rabbits, no dermal or systemic toxicity was observed at any dose 5 level.	Fluroxypyr is classified as a "not likely" human carcinogen.	Fluroxypyr does not demonstrate developmental or reproductive toxicity.
Glyphosate (SERA 2003a)	Non-irritating to slightly irritating if direct contact occurs; no permanent damage reported.	Inhalation is not an important route of Exposure because of its low volatility.	Poorly absorbed through skin.	Classified as Group E herbicide by US EPA: “Evidence of non-carcinogenicity for humans”.	Adverse reproductive effects have not been noted.
Sethoxydim (SERA 2001)	Irritating upon direct contact.	Some irritation at high exposure levels. Does not readily volatize.	Irritating to the skin.	Based on studies, no evidence of cancer risk.	Based on studies, no evidence of reproductive risks.

Herbicide	Eye Risk	Inhalation Risk	Dermal Risk	Cancer Risk	Reproductive Effects
Triclopyr (SERA 2003b)	May cause irritation to eyes.	Inhalation exposures not of toxicological concern.	May cause irritation to skin.	The evidence for carcinogenicity is marginal (Group D herbicide).	Does not produce reproductive or developmental effects at doses that do not produce maternal toxicity.

Forest managers frequently make decisions regarding the use of herbicides on forest lands. These decisions must be based not only on the effectiveness of these tools, but also on an understanding of the risks associated with their use. For the herbicides commonly used by the Forest Service in its management activities, Human Health and Ecological Risk Assessments (HERAs) have been prepared for the USDA Forest Service for nine of the ten herbicides proposed for use on the MTNF (aminopyralid, 2,4-D, dicamba, clopyralid, glyphosate, endothall, fluroxypr, sethoxydim, and triclopyr). In addition, risk assessment worksheets have been completed which are a computational tool developed for the USDA Forest Service by Syracuse Environmental Research Associates, Inc. (SERA). These worksheets perform many of the calculations used in the Human Health Risk Assessments (HHRA) and Ecological Risk Assessments (ERA) prepared for many of the herbicides used by the Forest Service. The proposed action would utilize herbicides at the rates the HERAs analyzed them. These documents are available online at: http://www.fs.fed.us/foresthealth/herbicide/risk.shtml and are hereby incorporated by reference.

The EPA provides comprehensive documentation for all the herbicides listed above and are available online at: http://www.epa.gov/herbicides/factsheets/chemical_fs.htm. In these documents, the process of risk analysis is used to quantitatively evaluate the probability that a given herbicide use might impose harm on humans or other species in the environment. It is the same process used for regulation of food activities, medicine, cosmetics and other chemicals.

Each USDA risk assessment used extensive literature searches and unpublished studies submitted to the U.S. Environmental Protection Agency to support the herbicide registration. Measures of risk were based on typical Forest Service uses of each herbicide. The proposed rates on the MTNF would be at the low end of their estimated range. For all six herbicides, the Risk Assessments showed no indications of risk to the general public. The upper ranges of plausible exposures of triclopyr, 2,4-D, and dicamba could pose some risk to herbicide applicators. Proposed MTNF use would be unlikely to reach these upper ranges of exposure, and protective equipment and safety precautions would further prevent risks from chronic exposure to workers.

Potential effects relate to direct contact with the herbicide, exposure to treated vegetation, or consumption of contaminated water, fish or vegetation. Direct exposure of workers or the public to vegetation that has been treated is low since notices will be posted. The greatest risk of exposure to herbicides would be to the workers mixing and applying them. However, compliance with label directions and project design criteria will minimize exposure of workers during application and during clean-up of apparatus. The herbicide label of some formulations places restrictions on re-entry of people to treated areas.

There is very little risk that the public may unknowingly come into direct contact with treated vegetation because areas treated with herbicides will be signed, as appropriate, to ensure users are informed of possible exposure (USDA Forest Service 2005b, page 2-18). The Project design criteria built into Alternative 2 reduce the risk for drift of herbicide or possibility of off-site movement into water or wetlands. In most cases, herbicides would be applied manually, which helps ensure limited environmental exposure to the chemicals, and label directions place restrictions on spraying at certain wind speeds. However, vapor drift is possible if equipment is calibrated for a small droplet size or fine mist and there is wind present. Except for Triclopyr, the chemicals chosen do not readily volatilize, and volatilization can be further minimized by applying the herbicide according to label directions. Finally, some of the chemical herbicide solutions have an odor that may persist at spray sites for several days.

The herbicides selected have relatively all or most of the following characteristics; short half lives, have low toxicity levels, and/or will not build up (bioaccumulate) in the environment. They also have limited ground mobility, and no application near water is proposed unless it is an herbicide that is approved for aquatic use or has a surgical application method such as hand wicking or stump applications. There are no proposed application methods that present substantial risk to ground water and soil contamination (see Soil and Water Resources section of this EA).

Based on the estimated levels of exposure and the criteria for chronic exposure developed by the U.S. Environmental Protection Agency, there is no evidence that typical or accidental exposures will lead to dose levels that exceed the level of concern. In other words, all anticipated exposures - most of which involve highly conservative assumptions - are at or below the reference dose. The use of the reference dose, which is designed to be protective of chronic or lifetime exposures, is itself a very conservative component of this risk characterization because the duration of any plausible and substantial exposures is far less than lifetime (SERA 2001, 2003a, 2003b, 2004a, 2004b, 2006, 2007, and 2009). None of the application rates will exceed the threshold amount of herbicide allowed on the label.

ALTERNATIVE 3 – NO HERBICIDES, LIMITED BIOLOGICAL CONTROL

Direct, Indirect, and Cumulative Effects: This alternative would allow control of NNIP population by utilizing manual, mechanical, biological, or cultural treatment methods only. No use of herbicides or root or seed head weevils would be authorized.

The effects would be the same as noted for Alternative 2, except that no chemical treatments would occur in Alternative 3. There would be no need to close areas during most mechanical or manual treatments, or after these actions. The disturbance associated with manual and mechanical treatment would likely be increased.

CUMULATIVE EFFECTS ON HUMAN HEALTH AND SAFETY

The cumulative effects analysis area for effects to human health and safety is defined as the 29 counties that contain the MTNF. This area was selected for human health and safety because it contains USFS lands that could be visited by people, and accounts for areas where MTNF neighbors live and travel through on a regular basis. The cumulative effects analysis timeframe is 10 years, because this timeframe coincides with the current Forest Plan planning cycle and this timeframe allows for initial and subsequent treatments of NNIP infestations to occur. A summary of past, present, and foreseeable activities related to NNIP control and human health and safety concerns is provided in Table 20. Alternative 1 would not directly contribute to any adverse cumulative impact to human health or safety since there would be no action taken. However, failure to control tree-of-heaven infestations on USFS lands could indirectly contribute to a cumulative increase in worker or visitor injuries because it could easily spread from remote areas to those areas more traveled.

INVASIVE PLANTS AND CLIMATE CHANGE

Because they are often highly competitive, invasive plant species are altering the plant composition of ecosystems and changing their structure and function over large landscape areas. In addition, the fine fuels they often add increases fire frequency in many areas and leads to increased dominance by invasive species and further degradation. Climate change is exacerbating these changes by altering the amount and seasonal distribution of precipitation seasonal temperature patterns in ways that often favor the invasive species. These types of changes, to which ecosystems are highly sensitive, will have a substantial regional impact in many areas.

We use models to predict how expected climate change will change the distribution of individual plant species. Predictions for individual species, however, are not sufficient to help us predict how their cumulative effects may drive changes in ecosystems, particularly changes in ecosystem structure and function. Changes in weather and climate can also have both individual and cumulative effects on ecosystems that can further facilitate the expansion and abundance of invasive plant species. Increases in invasive plant species usually results in a loss of services from the affected ecosystems. In many cases, these changes could even lead to ecosystem collapse over large landscape areas over the long term. Because so little is known about how climate change will facilitate invasive plants and their subsequent impact on ecosystems, it is only through adequate, detailed monitoring that we will be able to follow and recognize these changes.

Because of the rapidity of expected changes in climate, individuals of a native plant species may be lost from their lower-elevation limits faster than they will be able to migrate upward and establish into newly created habitat. This will result in stressed communities with fewer plant species distributed over large areas of the landscape. As ecosystems become simplified, their trophic levels are truncated and their trophic interactions reduced.

Such ecosystems potentially have an increase in the quantity of unused resources. These stressed communities thus become more open and their resources more available for the invasion and establishment of invasive plant species. These invaders may also be better adapted than native species to the new environmental conditions resulting from climate change. An exception might be native species of plants that can migrate from adjacent areas or regions into locations where they previously were excluded by climate as the new locations become more suitable. The greater the change, the more likely this facilitation of invasives will be. In addition to climate change are the species of invaders involved, the effects of the interactions of their species composition on the ecosystems, and the disturbance patterns those ecosystems are experiencing. On landscape scales, these ecosystem spatial and temporal variability have major effects on ecosystem susceptibility to invasive species. Climate change and associated vegetation change interacting with invasive species are also increasingly leading to large wildfires that can further facilitate the establishment of additional invasive plant species.

The most important option for management is early detection of ecosystem changes that result from climate change. This requires detailed, regularly scheduled monitoring. The next step is to actively prevent the spread of invasive plant species into ecosystems recognized as having become more susceptible. Prevention first requires an awareness of invasive species that pose a threat. These are not the same as native plant species that need to migrate to new locations to survive. Second, it requires recognition of what ecosystems are likely to become susceptible to invasion by these species as climate changes. Because of our current lack of understanding of just how climate change is going to change ecosystems and change their susceptibility to particular invasive species, our ability to recognize susceptible ecosystems and potential invasive plant species beforehand is limited.

Devising means to prevent the spread and establishment of invasive species will also be limited. Prevention may often not be possible because we will not know to which plant species a particular ecosystem has become susceptible to until after it has arrived. To prevent these species from becoming a problem, early detection, followed by a rapid response to eradicate these initial infestations, will be necessary. This will be possible only if these infestations are located as a result of regular, detailed monitoring.

Once invasive plant species have become established, a strategic approach for control and management becomes necessary. Successful control or management efforts for invasive species require an active program of restoration or rehabilitation. Because each situation is unique, each site will require a program designed for its unique landscape characteristics to successfully accomplish the needed restoration or rehabilitation.

SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Eradicating, reducing, or controlling NNIP populations will enhance the productivity of the Mark Twain National Forest. Alternative 1 - No Action could negatively impact long-term productivity by reducing the health and resiliency of the native plants and their ecosystems.

UNAVOIDABLE ADVERSE EFFECTS

No significant, unavoidable adverse effects were identified in the environmental consequences. All adverse effects were determined to be minor, short-term, localized, or within the range of natural variability.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321-4346 requires Federal agencies to disclose any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

Water Quality: There would be no irreversible or irretrievable commitments of water resources as a result of project-related direct, indirect, or cumulative effects as a result of implementing Alternative 2 or 3 and Project design criteria. This includes beneficial uses of waters of the state of Missouri, impaired water, and groundwater resources. While there would be short-term and minimal effects to hydrologic response in the affected watersheds under the action alternatives, the effects are expected to be within natural variability, difficult to detect and affects would not cause irretrievable commitments.

Soil Productivity: There would be no irreversible or irretrievable commitments of soil resources as a result of direct, indirect, or cumulative effects of implementing any of the action alternatives and associated Project design criteria.

Vegetative Resource: There would be no irreversible or irretrievable commitments of vegetative resources, including timber resources, as a result of direct, indirect, or cumulative effects of implementing any of the action alternatives and associated Project design criteria.

Threatened and Endangered Wildlife Species: There would be no irreversible or irretrievable loss of the eight threatened, two endangered and three candidate species known to be present or adjacent to the MTNF as a result of direct, indirect, or cumulative effects of implementing any of the action alternatives and associated Project design criteria.

MONITORING

NNIP Effectiveness/Implementation Monitoring

Infestations can change dramatically over time. Weed populations can expand exponentially, spreading along roads trails and stream corridors. Conversely, infestations can be reduced through treatment. Separate infestations can grow together to form a single, large infestation. An infestation can spread by forming separate subpopulations or patches where one previously existed.

An essential element of invasive plant management is observing changes (monitoring) in invasive species populations over time. This monitoring approach documents changes in invasive species populations or infestations through characteristics such as spatial expansion or contraction of a given infestation. Subsequent visit to a known site for re-measurement is considered infestation or population level monitoring. Agency guidance and protocols for inventory and monitoring of NNIP populations is provided in *Data Recording Protocols for Invasive Species Management (version 01.01.2009)*.

All NNIP inventory data is stored in Natural Resource Information System – Threatened and Endangered Species, Invasive Species module (NRIS-TESP/IS). In most cases, invasive plant infestations will be surveyed and then recorded in NRIS-TESP/IS when discovered and prior to treatment. Data and information on mapped and inventoried NNIP population include:

1. Site specific information for infestations (i.e. landform, aspect, soils, distance to water)
2. Species information for infestation sites (i.e. life form, phenology, canopy cover, size of infestation, management priority)
3. Plant species associated with infestations
4. Soil and vegetation information for infestations

Treatment and management of NNIP populations is tracked in the Forest Service Activity Tracking System (FACTS) and is integrated with NRIS-TESP/IS. Treatment information on NNIP includes:

1. Infestation area treated
2. Target species characteristics
3. Treatment activities (Herbicide application, Mechanical/physical, Cultural/Fire, Biocontrol)
4. Treatment effectiveness

Monitoring of herbicide use is tracked in FACTS for all projects and on a daily basis during the period of herbicide application. Specific herbicide records would include information on the date of control, application, type of herbicide, total amount of the herbicide used, method of application, species treated, and location of treatment. The daily logs require that start/stop times, weather conditions, distance to water and volume applied are recorded.

Forest Plan NNIS Monitoring

Effective Forest Plan monitoring and evaluation fosters improved management and more informed planning decisions. Monitoring and evaluation are learning tools that form the backbone of adaptive management. With these tools, information is collected and compiled to serve as reference points for the future; new scientific understanding and technology, changes in law and policy and resource conditions, growing concerns, trends and changing societal values are incorporated into forest planning; and the scientific validity and appropriateness of assumptions used in the development of the forest plan is evaluated.

Several kinds of activities can be referred to as "monitoring." Project implementation monitoring monitors compliance with LRMP standards and guidelines. Effectiveness monitoring evaluates how effective our management actions are at achieving desired outcomes.

A Monitoring and Evaluation ID Team (M&E IDT) and the Ranger Districts are required to conducts annual monitoring to review the minimum legally required monitoring items and the monitoring questions as outlined in the 2005 Land and Resource Management Plan Monitoring Guide.

The following are the required monitoring for NNIS in the 2005 Land and Resource Management Plan.

Monitoring: To what extent is Forest management contributing or responding to non-native invasive

Driver: Forest Plan Goal 1.2, Objective 1.2a, FSM 2080

Methods: Quantitative measure of the number of NNIS sites (and acres affected) on the Forest, including location and relationship to management activities (allotments, roads, trails, etc). Sites treated in the previous year will be revisited and the effectiveness of the treatment will be evaluated. Quantitative estimate of the rate of spread of NNIS adjacent to ATV trails, roads, allotments, etc. Rate of spread may be quantified as the percentage of trails/roads/allotments infested from year to year, or the miles/acres of trail/roads/allotments that are infested from year to year.

Frequency of Monitoring: Annual

Frequency of Evaluation: 5 years

Type of Monitoring: Implementation, Effectiveness,

Responsibility: Forest Botanist

Cooperators: District Wildlife Biologists

Monitoring: How many acres of existing noxious or non-native invasive species have been controlled?

Driver: Forest Plan Objective 1.2a

Methods: Quantitative measure of the number of NNIS sites and acres controlled in the current year. Use NRIS TESP/IS to list/summarize acres with NNIS. Use FACTS to list treatments each FY. There is an expectation that on average, 200 acres will be controlled in each year (given total minimum of 2.000 acres controlled over plan period.)

Frequency of Monitoring: Annual

Frequency of Evaluation: Annual

Type of Monitoring: Effectiveness, Implementation

Data Storage Method: NRIS TESP/IS module and FACTS activity reporting and Location

Responsibility: Forest Botanist

Cooperators: District Wildlife Biologists

OTHER REQUIRED DISCLOSURES

NEPA at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders." The need to control NNIP is directed by federal and state weed laws, Presidential executive order 13112, the National Invasive Species Act, and numerous other acts. This project is compliant the following Federal Acts and Authorities:

The Federal Insecticide, Fungicide and Rodenticide Act, the Missouri Herbicide Use Act, and the Missouri Herbicide Registration Act declare it is illegal to use herbicides in a manner inconsistent with label directions.

Endangered Species Act of 1973: Through federal action and by encouraging the establishment of state programs, the 1973 Endangered Species Act provided for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend.

National Historic Preservation Act of 1966 as Amended: The act requires Federal agencies to evaluate the impact of all federally funded or permitted projects on historic properties (buildings, archaeological sites, etc.).

The Clean Air Act: The law that defines federal responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer.

Executive Order 13186 (Neotropical Migratory Birds): EO directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act.

Federal Clean Water Act of 1948 (as amended in 1972 and 1987) - Establishes as federal policy the control of point and nonpoint pollution and assigns the States the primary responsibility for control of water pollution. Nonpoint source pollution typically results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification.

Section 303(d) of the Clean Water Act - This section requires the identification of water bodies that do not meet, or are not expected to meet, water quality standards or are considered impaired. The list of affected water bodies, and associated pollutants or stressors, is provided the Missouri Department of Natural Resources (http://www.dnr.mo.gov/env/wpp/waterquality/303d.htm) and approved by the US EPA. The 2010 List was approved by EPA on October 11, 2011 303(d). The 2010 List was used for the analysis and is located in the project file, Appendix B of the Hydrologist's report.

The Missouri Department of Natural Resources is developing a Pesticide General Permit for point source discharges resulting from the application of pesticides. This permit is being developed pursuant to recent EPA requirements under the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES) in response to the January 7, 2009 Federal Court of Appeals decision (National Cotton Council et al, v. EPA. The Mark Twain National Forest will apply for and comply with the States Pesticide General Permit were it is deemed required. Information on the States Pesticide General Permit can be found at: http://www.dnr.mo.gov/env/wpp/permits/pesticide.htm

Missouri Clean Water Law Chapter 640 - The law states that the Missouri Department of Natural Resources "shall ensure that the quality and quantity of the water resources of the state are maintained at the highest level practicable to support present and future beneficial uses. Beneficial uses are defined in the Missouri Code of State Regulations (CSR), Rules of Department of Natural Resources Title 10, Division 20, Chapter 7 Section 31: Water Quality Standards (10 CSR 20-7.031).

Missouri Clean Water Law Chapter 644 – Requires the State possess the authority required of states in the Federal Water Pollution Control Act as amended if it is to retain control of its water pollution control programs and to conserve the waters of the state and to protect, maintain, and improve the quality public water supplies and for domestic, agricultural, industrial, recreational and other legitimate beneficial uses and for the propagation of wildlife, fish and aquatic life; to provide that no waste be discharged into any waters of the state without first receiving the necessary treatment or other corrective action to protect the legitimate beneficial uses of such waters and meet the requirements of the Federal Water Pollution Control Act as amended; to provide for the prevention, abatement and control of new or existing water pollution; and to cooperate with other agencies of the state, agencies of other states, the federal government and any other persons in carrying out these objectives" (Missouri Department of Natural Resources 2010b)

Federal Safe Drinking Water Act (SDWA) - The Safe Drinking Water Act (SDWA) is the main federal law that ensures the quality of Americans' drinking water. Under SDWA, EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards (US EPA http://water.epa.gov/lawsregs/rulesregs/sdwa/index.cfm).

Federal Cave Resources Protection Act of 1988, Code of Federal Regulations Title 43, Part 37 - This act provides that Federal lands be managed to protect and maintain, to the external practical, significant caves.

Code of Federal Regulations (36CFR290) Cave Resource Management (Revised 2001) - This CFR directs the Forest Service on the confidentiality of cave location information based, the nomination, evaluation, and designation of significant caves, and the collection of information based on the Federal Cave Resource Protection Act of 1988.

In Addition, the following laws, regulation, and policies require the Forest Service to address the environmental impacts of NNIP species.

Forest Service National Strategy and Implementation Plan for Invasive Species Management (2004) – direction to reduce, minimize or eliminate the potential for introduction, establishment, spread and impact of invasive species across all landscapes and ownerships.

Non-Native Invasive Species Framework for Plants and Animals in the U.S. Forest Service, Eastern Region (2003) – directs all Forests and Grasslands in the Eastern Region of the Forest Service to institutionalize non-native invasive species (NNIP) programs.

Executive Order 13112 (1999) - directs all federal agencies to address invasive species and refrain from actions likely to increase invasive species problems.

U.S. Forest Service (1999) – "Stemming the Invasive Tide: Forest Service Strategy for Noxious and Non-native Invasive Plant Management".

Forest Service Manual 2900 (2011) – FSM 2900, Invasive Species Management, sets forth national Forest System policy, responsibilities, and direction for the prevention, detection, control, and restoration of effects from aquatic and terrestrial invasive species (including vertebrates, invertebrates, plants, and pathogens). All NFS invasive species management activities will be conducted within the following strategic objectives: 1) Prevention 2) Early detection & rapid response 3) Control & management 4) Restoration 5) Organizational collaboration.

Forest Service Manual 2150 and 2109.14 (1994) - Herbicide use management and coordination with the objective of ensuring the proper use of herbicides including: applicator certification and documenting herbicide approval.

Plant Protection Act (2000) [replaces and consolidates Federal Noxious Weed Act (1974) and Plant Quarantine Act (1912)] – requires cooperation of state, local and federal agencies in the application and enforcement of laws and regulations relating to management and control of noxious weeds.

North American Agreement on Environmental Cooperation (1994) - Council of the Commission on Environmental Cooperation to develop recommendations regarding exotic species which may be harmful.

Federal Insecticide, Fungicide, and Rodenticide Act (1947) - authority to use biological control agents as herbicides

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Chickasaw Nation of Oklahoma
Delaware Nation
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Iowa Tribe of Kansas and Nebraska
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Kaw Nation
Kialegee Tribal Town of the Creek Nation of Oklahoma
Kickapoo Traditional Tribe of Texas
Kickapoo Tribe in Kansas
Kickapoo Tribe of Oklahoma
Miami Tribe of Oklahoma
Muscogee (Creek) Nation of Oklahoma
Omaha Tribe of Nebraska & Iowa
Osage Nation
Otoe-Missouria Tribe of Oklahoma
Peoria Tribe of Indians of Oklahoma
Ponca Tribe of Indians of Oklahoma
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APPENDICES

APPENDIX A – NNIP SPECIES INVENTORIED ON THE MTNF

There are 32 NNIP species currently inventoried and mapped (1,966 sites) on approximately 32,428 acres on the Mark Twain National Forest.

Common Name	Scientific Name	General Habitat	# of inventoried sites	Total inventoried infested acres
Amur maple	*Acer ginnala*	old home sites, roadsides, office landscaping.	1	4
autumn olive	*Elaeagnus umbellata*	disturbed areas, fields, roadsides, riparian forests	18	162
beefsteak plant	*Perilla frutescens*	usually roadsides in riparian areas	3	9
border privet	*Ligustrum obtusifolium*	forest edges, roadsides, fencerows	1	1
bull thistle	*Cirsium vulgare*	disturbed areas, fields, roadsides, rangelands	19	87
bush or Amur honeysuckle	*Lonicera maackii*	mesic and dry-mesic forests, old home sites	1	4
California privet	*Ligustrum ovalifolium*	roadsides, campgrounds, fields, disturbed areas	1	1
Canadian thistle	*Cirsium arvense*	disturbed areas, fields, roadsides, rangelands	16	126
Caucasian Bluestem	*Bothriochloa bladhii*	glades, roadsides, open disturbed areas	1	1
cheat grass	*Bromus tectorum*	disturbed areas, fields, roadsides, rangelands	8	21
Chinese yam	*Dioscorea oppositifolia*	mesic forests and woodlands	2	1
curly pondweed	*Potamogeton pulcher*	aquatic in still or flowing waters	2	39
cutleaf teasel	*Dipsacus laciniatus*	disturbed areas, fields, roadsides	10	116
Eurasian water milfoil	*Myriophyllum spicatum*	aquatic in still or slowing waters	1	3

Common Name	Scientific Name	General Habitat	# of inventoried sites	Total inventoried infested acres
Fuller's teasel	*Dipsacus fullonum*	disturbed areas, fields, roadsides	1	<1
garlic mustard	*Alliaria petiolata*	mesic and riparian forests	4	29
ground ivy	*Glechoma hederacea*	mesic and riparian forests	1	4
Japanese honeysuckle	*Lonicera japonica*	forest edges, roadsides, fencerows	161	503
Japanese stiltgrass	*Microstegium vimineum*	mesic and riparian forests, campgrounds, fields, disturbed areas	32	131
Johnson grass	*Sorghum halepense*	disturbed areas, fields, roadsides, rangelands	61	558
kudzu	*Pueraria lobata*	disturbed areas, roadsides, forest edges	15	112
Albizia julibrissin	*Albizia julibrisien*	old home sites, roadsides	2	<1
multiflora rose	*Rosa multiflora*	riparian forests, old fields, roadsides	376	13,391
musk thistle	*Carduus nutans*	disturbed areas, fields, roadsides, rangelands	81	1083
perfume cherry	*Prunus mahaleb*	old home sites, roadsides, open woodlands	6	15
purple crownvetch	*Securigera varia*	disturbed areas, fields, roadsides, glades	50	598
Scotch cottonthistle	*Onopordum acanthium*	disturbed areas, fields, roadsides, rangelands	1	14
sericea lespedeza	*Lespedeza cuneata*	disturbed areas, fields, roadsides, rangelands	891	14,345
spotted knapweed	*Centaurea biebersteinii*	disturbed areas, fields, roadsides, rangelands	177	817
tree of heaven	*Ailanthus altissima*	disturbed areas, fields, roadsides	23	259
viper's bugloss	*Echium vulgare*	open areas on well drained soils	1	< 0.1
winter creeper	*Euonymus fortunei*	mesic forests, old home sites	1	<1

Source: Natural Resource Information System (NRIS) 2010

The NNIP species listed below have not yet been inventoried on the MTNF, but are known to occur within the state of Missouri. They are expected to be found on the MTNF within the next ten years, and may, in fact, already be present on the Forest.

Table A2. Potential NNIP

Common Name	Scientific Name	General Habitat
common buckthorn	*Rhamnus cathartica*	mesic forests and woodlands
Dahurian buckthorn	*Rhamnus davurica*	mesic forests and woodlands
leafy spurge	*Euphorbia esula*	disturbed areas, fields, roadsides, rangelands
Russian olive	*Elaeagnus angustifolia*	roadsides, campgrounds, fields, disturbed areas
Asian bittersweet	*Celastrus orbiculatus*	open woodlands, roadsides, fencerows
English ivy	*Hedera helix*	forests and woodlands
Japanese hops	*Humulus Japonicus*	bottomland forest and riparian areas
Japanese knotweed	*Polygonum cuspidatum*	riparian areas
white sweet clover	*Melilotus albus*	disturbed openlands

APPENDIX B – FOREST PLAN STANDARDS AND GUIDELINES FOR INNIP PROJECT

The following information is directly out of the 2005 Mark Twain Land and Resource Management Plan (Forest Plan). These are the standards and guidelines (S&G) that apply to the Integrated NNIP Control Project. S&Gs are mandatory actions to minimize environmental impacts. Additional actions to be taken or avoided when treating NNIP are prescribed under the Project Design Criteria (see EIS, Chapter 2)

Non-Native Invasive Species (NNIS) Management

Additional direction for NNIS management can be found in Forest Service Manual 2080.

Prioritize areas of NNIS for treatment based on threats to resources, species status, relationship to boundaries, size of the infestation, potential for further spread and effectiveness of available control measures,

Include NNIS control and prevention clauses in contracts and permits as needed.

Revegetate soils disturbed by National Forest management activities by allowing growth of existing on-site vegetation where possible and desirable.

Where on-site vegetation is not desirable, or not likely to quickly revegetate the site, use one or more of the following methods:

- **Fertilize to encourage growth of desirable on-site vegetation;**
- **Apply local surrounding organic mulch (i.e., leaf litter and pine needles) or covering with sterile weed-free straw to promote reestablishment of native vegetation;**
- **Reseed or replant with native species appropriate to the site or sterile annuals (wheat, rye, etc.) and fertilizing if necessary; or**
- **Scarify to establish seed bed.**

Although the use of native plants is preferred, non-native, non-invasive species may be used in areas such as recreation areas, administrative sites, artificial openings, and improved cool season pastures.

Use weed-free plant materials when restoring natural communities or planting warm season/cool season grasslands.

Grazing of livestock other than cattle and horses may be used for biological control of NNIS.

(*Forest Plan, Page 2-2*)

Water and Soil Resource Management

Riparian Management Zone (RMZ)

Within the RMZ the following activities are prohibited:

- **Grazing within 100 feet of streambanks;**
- **Fertilization;**

- **Servicing of equipment;**
- **Use of chemicals (unless needed to move towards desired condition).**

Within the RMZ the following activities should be avoided whenever possible:

- Equipment operation;

Watercourse Protection Zone (WPZ)

Within the WPZ the following activities are prohibited:

- **Fertilization;**
- **Servicing of equipment**
- **Use of chemicals (unless needed to move towards the desired condition).**

Within the WPZ the following activities should be avoided whenever possible:

- Mechanically constructed firelines for prescribed burns;
- Placement of livestock distribution tools (water tanks, salt blocks, etc.);
- Equipment operation;
- Use of chemicals (unless needed to move towards the desired condition)

Soil Productivity

Design all ground disturbing activities to prevent or minimize rutting, erosion, compaction, rapid runoff, disruption of water movement, and distribution or loss of water and soil quality.

Prevent or minimize sedimentation by employing adequate erosion control measures where earth-moving activities unavoidably expose areas of soil for extended periods of time.

Minimize ground-disturbing activities on soils highly subject to compaction during wet periods.

(*Forest Plan, Pages 2-3 thru 2-5*)

Terrestrial and Aquatic Habitat Management

Threatened, Endangered, and Sensitive species (TES)

Indiana Bat

Maternity Colonies

Minimize human disturbance in the maternity colony areas of use until the colony has left the maternity area for hibernation.

(*Forest Plan, Pages 2-7*)

Hine's Emerald Dragonfly

Control non-native invasive and/or undesirable plant species in fen habitats through the most effective means while protecting water quality.

(*Forest Plan, Page 2-8*)

Aquatic Habitat

Fishing Impoundments

Where determined to be a problem, aquatic species may be chemically controlled only when mechanical or biological control is impractical or not likely to be effective.

(*Forest Plan, Page 2-10*)

Springs, Seeps, Fens, Sinkholes, and Shrub Swamps

Prohibit all mechanical disturbances on springs, seeps, fens, sinkholes, and shrub swamps, regardless of size.

Establish a buffer zone of 100 feet in radius from the outside edge of:

- **Small, isolated fens less than 400-square feet in size;**
- **Seeps greater than 200-square feet in size or which support associated natural communities;**
- **Springs;**
- **Sinkholes; and**
- **Shrub swamps.**

Within these buffer zones, prohibit the following activities, unless needed to meet specific restoration objectives:

- **Rangeland management, including grazing;**
- **Significant soil disturbance;**
- **Use of chemicals;**
- **Vehicle and heavy equipment use;**
- **Refueling of equipment; and**
- **Fertilizer application.**

(*Forest Plan, Pages 2-13 and 2-14*)

Herbicide Use

Additional management direction for herbicide use can be found in Forest Service Manual 2150 and Forest Service handbooks 2109.14, (Herbicide Use Management and Coordination Handbook), 6709.11 (Health and Safety Code Handbook), and 7109.11.

Include clauses requiring Forest Service approval of herbicide use in contracts and permits as needed.

Use herbicides only after alternative analysis clearly demonstrates that herbicide use is the most effective means to meet overall management objectives.

The use of herbicides must comply with the product label.

Areas treated with herbicides shall be signed, as appropriate, to ensure users are informed of possible exposure.

Aerial application of herbicide shall not be allowed unless approved by the Forest Supervisor based on an environmental analysis that has shown it is the only environmentally sound and biologically effective method practicable.

Use the least impacting application method needed for effective control of the target species.

Wash and rinse equipment used in the mixing and application of herbicides and fertilizers in areas where runoff will not reach surface waters, wetlands, fens, sinks, or special other habitats.

When using herbicides within the RMZ, WPZ, and within 100 feet of sinkholes, springs, wetlands, and cave openings adhere to the following:

- **Minimize the use of herbicides, herbicides, fertilizers, or hazardous materials;**
- **Use only herbicides labeled for use in or near aquatic systems; and**
- **Use only hand application and single plant application of herbicides and herbicides, unless other methods are approved by the forest supervisor based on environmental analysis that has shown they are environmentally sound and the most biologically effective method practicable.**

(*Forest Plan, Pages 2-19 and 2-20*)

Management Prescription 1.1 & 1.2 Natural Community Restoration

Remove, control, or contain occurrences of non-native invasive species in existing native prairies upon discovery and in other natural communities as feasible.

(*Forest Plan, Pages 3-4 and 3-8*)

Management Prescription 5.1 Designated Wilderness

Standards and Guidelines

Vegetation Management

Control of noxious farm weeds by grubbing or with chemicals when they threaten lands outside Wilderness or are spreading within the Wilderness, provided control can be affected without serious adverse impacts on Wilderness values.

No man-caused vegetative manipulation will be permitted beyond the minimum needed for trails and signs. Exceptions are: (1) physical facilities and uses permitted under the establishing legislation, (2) vegetation may be removed to control man-caused wildfires and those natural wildfires and insect and disease outbreaks which threaten to spread beyond the Wilderness, (3) vegetation may be removed when absolutely necessary for rescue operations.

Existing vegetation communities, for example, legumes, food plots, fescue pastures, or pine plantations, which differ from the natural communities for a particular site, shall be allowed to revert to natural vegetation communities.

Only native or naturalized species and natural materials will be used for restoration work.

Environmental Management

Herbicide Use

Use herbicides in Wilderness only when necessary to prevent the loss of significant aspects of the Wilderness or to prevent significant losses to resource values on private or public lands bordering the Wilderness.

Obtain Regional Forester approval for all herbicide applications in Wilderness.

(*Forest Plan, Pages 3-18 and 3-19*)

Management Prescription 7.1 Developed Recreation Areas

Environmental Management

Use herbicides only to reduce hazards to the public or to treat non-native invasive species.

Apply herbicides during periods of low visitor use when possible.

(*Forest Plan, Page 3-46*)

APPENDIX C – NNIP PROPOSED TREATMENT METHODS

This appendix includes our proposed treatment methods for the Non-native Invasive Plants (NNIP) analyzed in the EIS. Please note that control techniques will vary depending on the species, the size of individual plants, the extent of the infestation, the location of the infestation, and individual site characteristics. These proposed methods were developed after review of literature, discussions with NNIP experts and from field experiences by Mark Twain National Forest personnel.

If the initial treatment method proves ineffective and the infestation is not reduced, or actually increases in size, alternative methods or different herbicides may be employed. For example, if bush honeysuckle re-sprouts despite being treated with glyphosate, we would consider treating with triclopyr the following year. To avoid generating herbicide resistance, the same product should not be used several years in succession; rather, various products should be used in rotation.

The Bradley Method is one approach to the manual control of weeds. This method consists of hand-weeding selected small areas of an infestation in a specific sequence, starting with the best stands of native vegetation (those with the least extent of weed infestation) and working towards those stands with the worst weed infestation.

The term "biological control" is used here to refer to the use of insects or pathogens to control weeds. Classical biological control (also known as importation biological control) is a technique for controlling exotic species by introducing natural enemies of the specific target species from the native range. Therefore, grazing as a control measure is discussed under the "Cultural Control" section. When using biological control methods, it is best to develop an integrated approach that incorporates other control techniques. This approach takes into consideration the life cycle of the beneficial organisms in relation to the plant development of the target species.

Manual/mechanical control: Most of the proposed manual treatments are highly selective, with very little potential to harm adjacent non-target plants. These include hand-cutting, hand-pulling, and digging. These practices would occur in areas where non-target plants are present. In addition, operators who are trained to distinguish between NNIP and native species will be used to further reduce the likelihood of negative impacts to non-target plants. This is particularly true in areas where rare species are known.

Mechanical actions are less selective. For example, mowing may reduce the vigor and reproductive ability of native plant species, in addition to the targeted NNIP. Mowing will also affect all vegetation in a treatment area, and so is best suited for highly infested sites that cover large areas.

Mowing is limited to those highly disturbed areas (see Chapter 2, Project design criteria) such as road-sides and range allotments because it disturbs most of the vegetation in the treated area. Although mowing can be timed in such a way that it favors native or desired plants, and discourages NNIP, mowing is generally detrimental to non-target plants. Limiting this practice to road-sides, range allotments, and similar sites, and targeting the treatment to the infested areas, will reduce this impact. In addition, many of these sites are already mowed as part of routine maintenance programs.

Chemical control: All proposed herbicides are capable of killing or injuring non-target plants. Five factors greatly influence the degree to which this may occur: 1) application method, 2) application conditions, 3) season of application, 4) choice of herbicide (based on selectivity), and 5) operator training.

1. Application Method. Most herbicides will be applied by hand through one of several methods. However, a boom-sprayer may be employed for use in some range allotments, especially those infested with sericea lespedeza. Most hand-application methods are very direct, since the operator is able to selectively and directly apply herbicide to the target plants. Hand-application methods include:

a) herbicide injection into woody trees and shrubs,
b) cut-stump or basal bark treatment of woody shrubs, and
c) the wand-applicator method which directly wipes herbicide on targeted foliage.

The foliar spray method is slightly less direct and selective. This method, which typically uses a hand-held or backpack sprayer, directs a narrow stream of herbicide on the target plant with minimal drift. And although there is some possibility that non-target plants can be sprayed with herbicide, the spray from backpack sprayers can be carefully controlled by drift guards and nozzle selection in order to produce a wide range of droplet size and spray-pattern size.

Finally, a boom applicator consists of a long horizontal tube, with multiple spray heads, that is mounted or attached to a tractor, ATV, or other vehicle (aerial applications are prohibited). The boom is carried above the weeds while spraying herbicide, which allows large areas to be treated rapidly with each sweep of the boom. Offsite movement due to vaporization or drift and possible treatment of non-target plants can be of concern when using this method.

To minimize this risk of herbicide drift from foliar spray methods, herbicide application will only occur when wind speeds are less than 10 mph to reduce herbicide drift , and when heavy rain events are not anticipated (both of these restrictions are outlined in the General Herbicide Application section of the Project design criteria in this EA).

2. Application Conditions. Weather conditions can affect the potential for herbicides to affect non-target plants. Windy days can cause spray drift, and heavy rainfall can wash herbicides off treated plants and carry them in surface runoff to non-target plants. To minimize this risk, herbicide application will only occur when wind speeds are less than 10 mph to reduce herbicide drift, and when heavy rain events are not anticipated (see General Herbicide Application section of the Project design criteria).

3. Season of Application. Application of herbicide during the growing season can kill or injure non-target plants if the application method is not selective. Project design criteria limit foliar herbicide spray in areas which are not heavily infested to times of the year when native plants are dormant, such as very early spring or late in the fall, whenever possible. At those times, the native plants are less susceptible to herbicide damage. For example, garlic mustard, Japanese honeysuckle, bush honeysuckle, multiflora rose and Autumn olive are actively photosynthesizing in late fall and very early in the spring while most native plants are dormant. Therefore, application of a foliar herbicide during those times will kill the NNIP while leaving most native plants unaffected.

Herbicide may also be applied during the growing season in order to respond quickly and effectively to the detection of a recently discovered, highly invasive NNIP or to impact NNIP when they are most vulnerable. This situation may temporarily harm some native species but will benefit those species in the long run by eliminating NNIP before they have an impact on natural communities.

4. Choice of Herbicide. Some herbicides are more selective than others. For example, clopyralid is the most selective herbicide among those proposed in this alternative. Although effective against many broadleaf plants, it is most selective toward members of the sunflower (Asteraceae), buckwheat (Polygonaceae), and pea (Fabaceae) families. Triclopyr is a broadleaf-specific herbicide, and therefore has little effect on grasses and other monocots. Sethoxydim is a narrowleaf-specific herbicide that targets monocots, such as grasses, but has little effect on broadleaf species. Use of these selective herbicides will leave more nontarget, native plants unaffected than a non-specific herbicide such as glyphosate or 2, 4-D.

Very often application of herbicide mixtures is necessary to obtain a desired degree of NNIP control. This is especially true where diverse vegetation is present on a site. Although any combination of herbicides can be legally mixed if each is labeled for the intended application and the mix is not prohibited by any of the labels, it is important to select compatible products and mix them properly. Labels provide recommendations on acceptable herbicide combinations and instructions for mixing. Improper herbicide mixing may result in phase separation or even herbicide deactivation (e.g., when mixing glyphosate and triclopyr).

On the other hand, certain herbicides may be more effective when applied together. For example, there is a documented synergism between fluroxypyr and triclopyr that results in improved control of key woody species. When mixing herbicides, one must use the most restrictive limitations as specified on the labels of the particular products (http://edis.ifas.ufl.edu/FR160)

5. Operator Training. All herbicide applicators will either be certified herbicide applicators or supervised by certified herbicide applicators. At NNIP sites where herbicide treatment must occur during the growing season, applicators must be able to distinguish between target NNIP and non-target species (Project design criteria). Herbicide solutions will be mixed in appropriate locations to prevent the potential for spills in naturally vegetated areas. Spray equipment will be inspected, and calibrated, prior to each day's use to minimize the potential for leaks or misdirection of spray streams (Appendix C).

Biological Control: Six insects and one fungus are proposed as biological control agents. While it is true that all but one of these biological control agents are not indigenous to the United States, all have extensive and successful records of prior use in the United States (Van Driesche et al. 2002). They have all been permitted for use by APHIS under the Plant Protection Act of 2000 (7 USC 7701 et seq.). Before permitting the release of nonindigenous biological control agents, APHIS thoroughly evaluates the potential risk of adverse impacts to non-target plants and animals (USDA APHIS 2004a & 2004b).

A. **Seed head weevils (*Larinus minutes, Larinus obtusus*) and Root weevil (*Cyphocleonus achates*)** Larinus minutes and Larinus obtusus are small, black soft seedhead weevil introduced in the United States in early 1990s. The weevils has been released in Arizona, California, Colorado, Idaho, Minnesota, Montana (established), Nebraska, Oregon (established), South Dakota, Utah, Washington (established), and Wyoming (established) as a part of a biological control program to control spotted and diffuse knapweed.

   Biological control of spotted knapweed in Missouri, begun in 2008 and involved the release of two weevils (Larinus minutus/obtusus) and root borer weevils (Cyphocleonous achates) that are host-specific to the spotted knapweed. Seedhead weevils, were released at over 200 sites in Missouri. These releases were made by the Missouri Department of Transportation, Missouri Department of Conservation, and University of Missouri Extension. Knapweed seedhead flies (Urophora quadrifasciata) that feed on spotted knapweed in Missouri. It will take several years for populations of these insects to grow enough to begin providing significant control of the spotted knapweed.

B. **a rust fungus (Puccinia carduorum)**. This rust has been accidentally introduced to North America and also was the first plant pathogen tested and released in the United States for biological control of musk thistle. In greenhouse tests, limited infection occurred on some species of Cirsium, Cynara, Saussurea, and Sylibum, but older plants were resistant. Attempts to maintain P. carduorum on 22 native North American species of Cirsium and C. scolymus failed. Musk thistle was the only host that became severely diseased (Politis et al., 1984 ; Bruckart et al., 1996). No rust development was observed on any of the non-target plants (10 North American Cirsium spp. and artichoke) in a field trial carried out in 1988 in Virginia (Baudoin et al., 1993). Puccinia carduorum has not been reported from native North American Cirsium species. It spread rapidly in the eastern United States and was found in Missouri in 1994 (Baudoin and Bruckart, 1996). By 1997, it was detected in 37 counties in Missouri. Although the disease does not kill the plant or reduce its seed production, it coexists with the musk thistle weevils and apparently does not interfere with their feeding on the thistle.

C. **Leafy spurge flea beetles.** The Brown-legged leafy spurge flea beetle (Aphthona lacertosa), the copper leafy spurge flea beetle (Aphthona flava) and the Black dot leafy spurge flea beetle (Aphthona nigriscutis) have been used as biological control agents targeting leafy spurge for more than twenty years in western rangelands (Anderson et al. 1999). Quarantine testing has shown that Aphthona flea beetles are very host specific and feed only on a narrow range of hosts restricted to the spurge family (Bourchier 2006). A potential risk to the few native plants in the genus Euphorbia is, however, acknowledged (Weeden et. al. 2008). The only known non-target plants fed upon by the proposed beetles are in the subgenus Esula of the genus Euphorbia. In Missouri the sub-genus Esula is represented by the following species: Euphorbia commutata, Euphorbia cyparissias, Euphorbia esula, Euphorbia obtusata, and Euphorbia spathulata. Euphorbia commutata, E. obtusata, and E. spathulata are native species and are known to occur within the cumulative affects area. However, none of these species are federally listed as threatened or endangered, RFSS or state-listed.

D. **Milfoil weevil.** Unlike the other proposed biological control agents, the milfoil weevil is indigenous to the United States, including Missouri. It can therefore be released legally at sites in the United States without quarantine studies and APHIS approval and is recognized as offering reduced risk to non-target vegetation and distinct logistical advantages over biological control agents introduced from other parts of the world (Sheldon and Creed 1995). The milfoil weevil feeds specifically on water-milfoil plants (Myriophyllum spp.), and traditionally feeds on the native northern water-milfoil (Myriophyllum sibiricum). However, upon introduction it will feed on Eurasian water-milfoil (Sheldon and Creed 1995). It is possible that the introduction of the milfoil weevil to waters presently free of the species could result in long-term suppression of any native10 water-milfoil populations as well as the targeted Eurasian water-milfoil. However, any reductions in native populations of water-milfoils would be minor compared to the long-term benefits to native vegetation as a result of Eurasian water-milfoil control.

Cultural Control: Cultural control methods include the use of competition, grazing mammals, scorching, smothering, and Waipuna® hot foam.

1. Competition. Competition involves planting native perennials (typically warm-season grasses) on treated infestations. If managed properly, in most situations the native perennials will colonize the site and out-compete the NNIP.

2. Grazing mammals. Grazing involves the use of mammals, such as cows, goats, and sheep, to control certain NNIP. By itself, grazing will rarely eradicate NNIP from a particular infestation. However, when grazing treatments are combined with other control techniques, such as herbicides or mowing, severe infestations can be reduced and small infestations may be eradicated. In accordance with the Mark Twain National Forest Land and Resource Management Plan (USDA Forest Service. 2005a), “grazing of livestock other than cattle and horses may be used for biological control of NNIP.” However, the Mark Twain National Forest Land and Resource Management Plan (USDA Forest Service, 2005a) also places the following restrictions on grazing, which have been incorporated into the Project design criteria:

Grazing is not allowed within 100 feet of springs, significant seeps, fens, other wetland features, or the break of a sinkhole basin.

Grazing is allowed within the RMZ only under the following conditions: Livestock are fenced at least 100 feet away from stream banks;

[10] There are five species of milfoils in Missouri (Flora of Missouri Project, 2008), and while three of these are native (*Myriophyllum aquaticum, M. heterophyllum*, and *M. pinnatum*) and are known to occur within the cumulative effects boundary, none are Federal or State listed, or considered to be Regional Forester Sensitive Species.

Grazing shall not be allowed to degrade the RMZ or WPZ, or their functionality.

There are two types of grazing treatments the Forest would use of controlling NNIP, pasture treatment and targeted treatments. Pasture treatment would utilize goats or sheep to utilized specific browse NNIP, such as sericea lespedeza, in an existing active or vacant grazing allotment. This may be done in conjunction with on-going permitted cattle grazing. Targeted grazing treatment would consist of constructing temporary enclosure (usually electric fence) around an infestation, such as honeysuckle or kudzu and stocking the enclosure with goats. In some cases the animals may be tethered and not fenced.

Where grazing activity is an appropriate method of treatment, specific criteria must be met.

- The target NNIP must be the primary forage (browse) available
- Sufficient forage (browse) must be available to make use of grazers and stocking rates cannot exceed the capacity of the treatment area
- Must have control of timing and duration of grazing use

3. Scorching. Use the flame of a propane weed torch to scorch or wilt green leaves. This is done either very early or late in the growing season when exotics are green and native perennials are mostly below ground. It does not start a ground fire. Scorching will kill one year’s growth of annual and biennial weeds. Especially useful for garlic mustard, beefsteak plant, and Japanese stiltgrass.

4. Smothering. Smothering small infestations with mulch (hay, grass clippings, wood chips, etc.) or other type of ground cover (newspaper clippings, plastic sheeting) prevents weed seeds and seedlings from receiving sunlight necessary to survive and grow.

5. Waipuna® Hot Foam. The Waipuna®™ Hot Foam system is comprised primarily of a diesel-powered boiler and foam generator, which deliver hot water with a foam surfactant to target weeds via a supply hose and a treatment wand. The superheated hot foam is applied to the targeted vegetation at a precise temperature (93 degrees C, 200 degrees F) and pressure; the foam traps the steam, giving it time to "cook" or "blanch" the vegetation. This causes a cellular collapse of the treated aboveground vegetation. This control method is limited in mobility and is best used near developed sites such as work centers, campgrounds, trailheads, and along some roadsides.

APPENDIX D – SOIL/HERBICIDE INTERACTIONS

Herbicide effects conclusions are based on results from the WIN-PST model, which was developed by the NRCS. The WIN-PST model rates the loss potential of a specific herbicide when applied to a specific soil. Soil physical and chemical characteristics, such as texture, organic matter content, and surface horizon depth are considered in the ratings. WIN-PST computes the leaching potential, solution runoff potential, and the adsorbed runoff potential for both the soil and the given herbicide. Those outputs are then combined to develop soil-herbicide interaction loss potentials.

Based on the SURGO soil data for the Mark Twain and the herbicides proposed for use, No Soil – Herbicide Inaction ratings exceeded intermediate for spot applications. This doesn't imply that there could be ratings of high since some information, hydrological group and kfactors, are missing from the SURGO database.

All WIN-PST reports are available at: Mark Twain National Forest - Projects. Herbicide and soil loss potentials are described below.

SOILS

Soil Leaching Potential (SLP): The sensitivity of a given soil to herbicide leaching below the root-zone. Characterizes those soil properties that would increase or decrease the tendency of a herbicide to move in solution with water and leach below the root zone. A high rating indicates the greatest potential for leaching.

Soil Solution Runoff Potential (SSRP): The sensitivity of a given soil to herbicide loss dissolved in surface runoff that leaves the edge of the field. A high rating indicates the greatest potential for solution surface loss.

Soil Adsorbed Runoff Potential (SARP): Represents sensitivity of a soil to herbicide loss adsorbed to sediment and organic matter that leaves the edge of the field. SARP characterizes those soil properties that would increase or decrease the tendency of a herbicide to move in surface runoff attached to soil particles. A high rating indicates the greatest potential for sediment/herbicide transport.

HERBICIDE

Herbicide Leaching Potential (PLP): Indicates the tendency of a herbicide to move in solution with water and leach below the root zone. A low rating indicates minimal movement and no need for mitigation.

Herbicide Solution Runoff Potential (PSRP): Indicates the tendency of a herbicide to move in surface runoff in the solution phase. A high rating indicates the greatest potential for herbicide loss in solution runoff.

Herbicide Adsorbed Runoff Potential (PARP): Indicates the tendency of a herbicide to move in surface runoff attached to soil particles. A low rating indicates minimal potential for herbicide movement adsorbed to sediment, and no mitigation is required.

The following herbicide ratings are screened based on applications method, spot foliar or broadcast foliar. The majority of herbicide application on the Mark Twain NF would be spot applications. When broadcast applications are completed it is usually done on areas dominated by vegetative cover. Foliar herbicide applications utilize a directed spray when weeds are at nearly full canopy. This increases interception of herbicide by the plant and decreases contact with the soil.

Herbicide	Spot Application			Broadcast - Foliar		
	PLP	PSRP	PARP	PLP	PSRP	PARP
2,4-Dichlorophenoxyacetic acid	VERY LOW	LOW	LOW	LOW	LOW	LOW
Aminopyralid	VERY LOW	LOW	LOW	VERY LOW	LOW	LOW
Clopyralid	LOW	LOW	LOW	INTERMEDIATE	LOW	LOW
Dicamba	LOW	LOW	LOW	INTERMEDIATE	LOW	LOW
Endothall	VERY LOW	LOW	LOW	VERY LOW	LOW	LOW
Fluroxypyr	VERY LOW	LOW	LOW	LOW	INTERMEDIATE	LOW
Fosamine ammonium	VERY LOW	LOW	LOW	VERY LOW	LOW	LOW
Glyphosate	VERY LOW	LOW	LOW	VERY LOW	INTERMEDIATE	INTERMEDIATE
Imazapyr	LOW	LOW	LOW	INTERMEDIATE	INTERMEDIATE	LOW
Sethoxydim	VERY LOW	LOW	LOW	VERY LOW	LOW	LOW
Triclopyr	LOW	LOW	LOW	INTERMEDIATE	INTERMEDIATE	LOW

INTERACTIONS

Leaching

Soil-Herbicide Interaction Leaching Potential (ILP)

The Soil-Herbicide Interaction Leaching Potential (ILP) is derived from the Soil Leaching Potential (SLP) and Herbicide Leaching Potential (PLP).

Soil-Herbicide Interaction Leaching Potential (ILP)					
		Herbicide Leaching Potential (PLP)			
		High*	Intermediate	Low	Very Low
Soil Leaching Potential (SLP)	High	High	High	Intermediate	Low
	Intermediate	High	Intermediate	Low	Very Low
	Low	Intermediate	Low	Low	Very Low
	Very Low	Low	Low	Very Low	Very Low

***Based on SURGO soil data and proposed herbicides, there are no ILP rating of High for spot applications. There are some soil map units rated high for foliar applied broadcast application for Aminopyralid, Clopyralid, Fluroxypr, and Triclopyr**

Solution Runoff

Soil-Herbicide Interaction Solution Runoff Potential (ISRP)

The Soil-Herbicide Interaction Solution Runoff Potential (ISRP) is derived from the Soil Solution Runoff Potential (SSRP) and Herbicide Solution Runoff Potential (PSRP).

Soil-Herbicide Interaction Solution Runoff Potential (ISRP)				
Soil Solution Runoff Potential (SSRP)	Herbicide Solution Runoff Potential (PSRP)			
		High*	**Intermediate**	**Low**
	High	High	High	Intermediate
	Intermediate	High	Intermediate	Low
	Low	Intermediate	Low	Low

***Based on SURGO soil data and proposed herbicides, there were no ISRP rating of High. Some soil map units rated high for foliar applied broadcast application for Aminopyralid, Clopyralid, Fluroxypyr, and Triclopyr**

Adsorbed Runoff

Soil-Herbicide Interaction Adsorbed Runoff Potential (IARP)

The Soil-Herbicide Interaction Adsorbed Runoff Potential (**IARP**) is derived from the Soil Adsorbed Runoff Potential (**SARP**) and Herbicide Adsorbed Runoff Potential (**PARP**).

Soil-Herbicide Interaction Adsorbed Runoff Potential (IARP)				
Soil Solution Runoff Potential (SARP)	Herbicide Adsorbed Runoff Potential (PARP)			
		High*	**Intermediate**	**Low**
	High	High	High	Intermediate
	Intermediate	High	Intermediate	Low
	Low	Intermediate	Low	Low

***Based on SURGO soil data and proposed herbicides, there are no IARP rating of High. Some soil map units rated high for foliar applied broadcast application of Aminopyralid, Clopyralid, Fluroxypr, and Triclopyr**

APPENDIX E – HERBICIDE TOXICITY RATINGS

The following table shows the potential for herbicide to move off site based on solubility, the herbicides affinity to sorb to organic carbons and the herbicides half –life and are rated combining soil ratings and herbicide ratings. The table displays ratings for spot and broadcast foliar application based on standard application rates for each herbicide. WIN-PST also combines ILP, ISRP and IRP ratings with herbicide toxicity to humans and fish in an Exposure Adjusted Toxicity Interaction Matrix that results in overall Human Hazard and Fish Hazard WIN-PST Ratings.

Herbicide Active Ingredient Rating Report from WIN-PST 3.1												
Active Ingredient (Common Name)	Solubility in Water (ppm)	Koc	HL	Human Toxicity (ppb)	Fish Toxicity		SPISP II Herbicide Rating			Exposure Adjusted Toxicity Category		
					MATC (ppb)	STV	Leaching Spot [Broadcast]	Runoff Solution Spot [Broadcast]	Runoff Adsorbed Spot [Broadcast]	Human (Water)	Fish (Water)	Fish (Sediment)
2,4-D	890	20	10	70	4,247	84,940	V (fp) [L (f)]	L (fp) [L (f)]	L (fp) [L (f)]	L	V	V
Aminopyralid	212	1,000	26	3,500	1,360	1,360,000	V (fpl) [V (fl)]	L (fpl) [L (fl)]	L (fpl) [L (fl)]	V	V	V
Clopyralid	1,000	2	30	3,500	20,832	41,664	L (fp) [I (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	V	V
Dicamba	4,500	5	14	4,000	126	630	L (fp) [I (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	L	V
Endothall	100,000	124	7	100	126	15,624	V (fp) [V (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	L	V
Fluroxypyr	136,000	200	36.3	3,500	2,349	469,800	V (fp) [V (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	V	V
Fosamine ammonium	1,790,000	150	8	70	26,178	3,926,700	V (fp) [L (f)]	L (fp) [L (f)]	L (fp) [L (f)]	L	V	V
Glyphosate	12,000	3,500	47	700	8,290	29,015,000	V (fp) [V (f)]	L (fp) [I (f)]	L (fp) [I (f)]	V	V	V
Imazapyr	11,000	100	90	17,500	62,970	6,297,000	L (fp) [I (f)]	L (fp) [I (f)]	L (fp) [I (f)]	V	V	V
Sethoxydim	4,390	100	5	630	154	15,400	V (fp) [V (f)]	L (fp) [L (f)]	L (fp) [L (f)]	V	L	V

Herbicide Active Ingredient Rating Report from WIN-PST 3.1												
Active Ingredient (Common Name)	Solubility in Water (ppm)	Koc	HL	Human Toxicity (ppb)	Fish Toxicity		SPISP II Herbicide Rating			Exposure Adjusted Toxicity Category		
					MATC (ppb)	STV	Leaching Spot [Broadcast]	Runoff Solution Spot [Broadcast]	Runoff Adsorbed Spot [Broadcast]	Human (Water)	Fish (Water)	Fish (Sediment)
Triclopyr	435	27	155	350	23,714	640,278	L (fp) [I (f)]	L (fp) [I (f)]	L (fp) [I (f)]	V	V	V

Legend

X -- eXtra high

H -- High

I -- Intermediate

L -- Low

V -- Very low

Conditions that affect ratings:

(none) -- Broadcast application (default); applied to more than 1/2 the field

b -- Banded application; applied to 1/2 the field or less

p -- Spot application; applied to 1/10 of the field or less

(none) -- Surface applied (default); applied to the soil surface

i -- Soil incorporated; with light tillage or irrigation

f -- Foliar application; directed spray at nearly full crop/weed canopy

(none) -- Standard application rate (default); greater than 1/4 lb/acre

l -- Low rate of application; 1/10 to 1/4 lb/acre

 -- Ultra Low rate of application; 1/10 lb/acre or less

SPISP II P-Ratings:

Leaching -- Herbicide Leaching Potential

Runoff Solution -- Herbicide Solution Runoff Potential

Runoff Adsorbed -- Herbicide Adsorbed Runoff Potential

Definitions

Koc - Soil organic carbon sorption coefficient of an active ingredient in mL/g. Used to compute the P-Ratings. Herbicides vary in how tightly they are adsorbed to soil particles. Koc measures the affinity for herbicides to sorb to organic carbon. The higher the Koc value, the stronger the tendency to attach to and move with soil. Soil pH can affect the Koc of ionic and partially ionic herbicides. A herbicide with an anion as the active species would have a Koc set low to account for that herbicide's inability to sorb to soil particles. A cationic active species would tend to bind strongly with soil and therefore have a relatively high Koc. Herbicide Koc values greater than 1,000 indicate strong adsorption to soil. Herbicides with lower Koc values (less than 500) tend to move more with water than adsorbed to sediment.

Solubility (SOL) - Solubility is the measure of an active ingredient's ability to dissolve in water at room temperature. It is expressed in mg/L (ppm). Used to compute P-Ratings. Solubility is a fundamental physical property of a chemical and affects the ease of wash off and leaching through soil. In general, the higher the solubility value, the greater the likelihood for movement.

Half-Life (HL) - Half-life of an active ingredient under field conditions, in days. Sometimes referred to as field dissipation half-life. Used to compute the P-Ratings. Half-life is the time required for a herbicide to degrade to one-half of its previous concentration. Each successive elapsed half-life will decrease the herbicide concentration by half. For example, a period of two half-lives will reduce a herbicide concentration to one-fourth of the initial amount. Half-life can vary by a factor of three or more from reported values depending on soil moisture, soil pH, temperature, oxygen status, soil microbial population, and other factors. Additionally, resistance to degradation can change as the initial concentration of a chemical decreases. It may take longer to decrease the last one-fourth of a chemical to one-eighth than it took to decrease the initial concentration to one-half. In general, the longer the half-life, the greater the potential for herbicide movement.

Human Toxicity - Long-term human toxicity of an active ingredient in parts per billion (ppb). Toxicities are based on availability in the priority order: MCL, HA, HA* (HA and HA* are used for Cancer Groups C, D, E and unclassified) and CHCL*. MCL is used whenever available by the EPA Office of Water. HA and HA* are used for Cancer Groups C, D, E and unclassified. CHCL* is used for Cancer Groups A, B1 and B2 when MCL is unavailable.

HA and HA* - Health Advisory, determined by EPA's Office of Water (OW). The concentration of a chemical in drinking water that is not expected to cause any adverse non-carcinogenic effects over a lifetime exposure with a margin of safety. HA is compared to the PLP or PSRP for humans. HA* is calculated using the EPA method for calculating HA based on Reference Dose (RFD). RFD values are from the EPA Office of Herbicide Programs (OPP), EPA, or World Health Organization (WHO).

Herbicide	Human Toxicity
2,4-Dichlorophenoxyacetic acid	Group D--Not classifiable as to human carcinogenicity
Aminopyralid	Not likely to carcinogenic to humans. HA = 0.5 X 7000.
Clopyralid	Not likely to be carcinogenic to humans. HA* = RfD X 7000.
Dicamba	Not likely to be carcinogenic to humans
Endothall	Not likely to be carcinogenic to humans
Fluroxypyr	Not likely to be carcinogenic to humans. HA* = RfD X 7000.
Fosamine ammonium	OPP RfD used to calculate HA. HA = RfD X 7000.
Glyphosate	Group E-- Evidence of non -carcinogenicity for humans
Imazapyr	Group E: Not oncogenic. 12-month dog NOEL = 250 mg/kg/day. Chronic NOEL UF = 100. HA = (250/100) X 7000.
Sethoxydim	Not likely to be carcinogenic to humans. HA* = RfD X 7000.
Triclopyr	Group D--Not classifiable as to human carcinogenicity. HA* = RfD X 7000.

SPISP II Soil / Herbicide Loss Interaction Ratings: ILP, ISRP, and IARP. PLP, PSRP and PARP herbicide ratings are combined with SLP, SSRP and SARP soil ratings in a Soil/Herbicide Interaction Matrix that results in ILP, ISRP and IARP Soil/Herbicide Interaction ratings. These interaction ratings provide a relative potential for herbicide loss for each soil/herbicide combination. ILP ratings indicate the potential for herbicides to leach below the root zone. ISRP ratings indicate the potential for herbicides to move beyond the edge of the field dissolved in solution runoff. IARP ratings indicate the potential for herbicides to move beyond the edge of the field adsorbed to sediment and organic matter which is suspended in runoff water. WIN-PST also combines ILP, ISRP and IRP ratings with herbicide toxicity to humans and fish in an Exposure Adjusted Toxicity Interaction Matrix that results in overall Human Hazard and Fish Hazard WIN-PST Ratings.

MATC - Maximum Acceptable Toxicant Concentration (MATC*) in ppb. MATC* is the long-term toxicity value for fish. The MATC* for an active ingredient can be determined empirically by performing long-term or early life-stage toxicity tests. These test results produce the No Observable Effect Concentration (NOEC) and Lowest Observable Toxicant Concentration (LOEC).

STV - Sediment Toxicity Value. STV = MATC x Koc. Compared to the PARP when the species of concern are fish. STV provides toxicity of herbicide sorbed to detached soil leaving the field. Koc is used in STV determination to estimate herbicide concentration in sediment pore water. Fish MATC is used in lieu of toxicity data to sediment dwelling animals for which test data are rare. STV threshold ratings are the same as those used for MATC evaluation. The method for sediment short-term toxicity of nonionic herbicides (Di Torro et al., 1991), was modified to determine long-term toxicity. STV is also used to evaluate ionic herbicide which account for about 25% of herbicides. This is achieved by use of an adjusted Koc in the NAPRA PPD, which accounts for herbicide ionic properties.

APPENDIX F – HERBICIDE USE BY WATERSHED

The following table displays the estimated maximum extent under the proposed action in which herbicides could be applied over the next ten years to all known NNIP infestations where herbicide use has been deemed an appropriate treatment. The amounts are expressed in lbs of a.e. or a.i. per acre based on an average or recommend application rate. The proposed action is an integrated approach to NNIP control and herbicides will only be used where site conditions are appropriate.

HU NAME	HUC	Total Infestation for all NNIPs	2,4-D 1 lbs/ac	Glyphosate 2 lbs/acre	Fluroxypyr 0.5 lbs/acre	Triclopyr 1 lbs/acre	Dicamba 0.3 lbs/acre	Cholpyralid 0.35 lbs/acre	Aminopyralid 0.11 lbs/acre	Fosamine 2 lbs/acre
Arnold Branch-North Fork River	110100060504	0			0	0				
Bald Ridge Creek-Big Piney River	102902020402	14	14	27		14	4			
Barbers Creek-Swan Creek	110100030303	194	168	290	13	70	50	8	2	201
Barren Fork Creek	110100080302	4,703	4,650	192	27	98	1,395	1,594	501	101
Bat Cave Hollow-Eleven Point River	110100110302	1,026	983	1,299	21	376	195	117	0	55
Bee Fork	110100070102	162	67	106	48	95	20	5	2	106
Big Barren Creek	110100080606	41	1	2	20	40	0			
Big Brushy Creek	110100070604	55						19	6	
Big Creek	110100080309	79			33	65				
Big Creek-Table Rock Lake	110100011204	55	21	42	17	34	6			42
Big Paddy Creek	102902020204	54			27	54				
Big Piney River	102902020404	395	43				13	138	43	
Birch Creek	110100110202	137	137				41	48	15	
Blue Creek-Swan Creek	110100030304	15			7	15				
Briar Creek-Current River	110100080902	1			1	1				
Brown Branch-Beaver Creek	110100030208	74			37	74				

HU NAME	HUC	Total Infestation for all NNIPs	2,4-D 1 lbs/ac	Glyphosate 2 lbs/acre	Fluroxypyr 0.5 lbs/acre	Triclopyr 1 lbs/acre	Dicamba 0.3 lbs/acre	Cholpyralid 0.35 lbs/acre	Aminopyralid 0.11 lbs/acre	Fosamine 2 lbs/acre
Brushy Creek	110100030209	323	64	129	129	264	18	2		118
Brushy Creek	110100070304	65	16	32	24	48	5			32
Buffalo Creek	110100080610	47	30	59	9	18	9			51
Butler Creek	110100010801	11			6	11				
Cane Creek	110100030211	403	19	16	192	385	6	4	1	16
Caney Creek-Beaver Creek	110100030205	91	6		42	85	2	2	1	
Cedar Bottom Creek-St Francis River	080202020402	341	341	683		341	102			
Cedar Creek-Current River	110100080611	16	16	31	0	0	5			
Cedar Creek-Swan Creek	110100030302	158	142	184	8	16	43	18	6	184
Cedar Creek-Table Rock Lake	110100010803	5	5	11		5	2			
Clifty Creek	110100060102	153	118	30	17	50	35	41	11	
Courtois Creek	071401020305	336	249	497	44	87	75			204
Crane Pond Creek	080202020303	407	360	719	23	407	108			
Crooked Branch-North Fork River	110100060501	24	13	18	6	12	4	1	0	
Crooked Creek-Huzzah Creek	071401020402	91	76	140	8	15	23	2	1	41
Cub Creek	071401020301	62	62	39			19	15	5	39
Denny Hollow-Eleven Point River	110100110206	51	25	50	13	26	7			50
Dry Creek	071401020407	6			3	6				
Dry Creek	110100060107	610	359	510	125	252	107	37	11	230
East Fork Big Creek	110100030704	114			57	114				
Elliot Branch-Roubidoux Creek	102902010506	16	6		5	10	2	2	1	
Flat Creek	110100020409	4	4	3			1	1	0	

HU NAME	HUC	Total Infestation for all NNIPs	2,4-D 1 lbs/ac	Glyphosate 2 lbs/acre	Fluroxypyr 0.5 lbs/acre	Triclopyr 1 lbs/acre	Dicamba 0.3 lbs/acre	Cholpyralid 0.35 lbs/acre	Aminopyralid 0.11 lbs/acre	Fosamine 2 lbs/acre
Fourche a Renault	071401040203	1	1				0	0	0	
Fourche Creek	110100090102	30	3	5	14	27	1			
Fowler Creek-Cedar Creek	103001021004	100			50	100				
Gourd Creek-Little Piney Creek	102902030106	2	2	5		2		1		
Greasy Creek-North Fork River	110100060103	373	256	340	59	118	77	30	9	339
Hazel Creek-Courtois Creek	071401020303	3,137	3,080	6,007	28	57	924	27	8	43
Headwaters Big Barren Creek	110100080605	83			42	83				
Headwaters Big Piney River	102902020101	258	258	271		135	77	90	13	
Headwaters Big River	071401040101	550	154	308	66	138	46			296
Headwaters Cane Creek	110100070901	336	278	557	29	57	83			30
Headwaters Crooked Creek	071401020205	69	45	90	12	23	14			90
Headwaters Dry Creek	110100060106	183	122	210	30	61	37	6	2	58
Headwaters Huzzah Creek	071401020401	2,193	1,954	666	120	256	586	567	178	634
Headwaters Meramec River	071401020201	6,847	6,512	512	167	398	1,954	2,190	688	387
Headwaters North Fork River	110100060101	11	2		4	9	1	1	0	
Headwaters Sinking Creek	110100080301	281	120	240	80	161	36			240
Headwaters Tenmile Creek	110100070902	2								
Hutchins Creek-Meramec River	071401020203	107	57	50	25	50	17	11	4	50

HU NAME	HUC	Total Infestation for all NNIPs	2,4-D 1 lbs/ac	Glyphosate 2 lbs/acre	Fluroxypyr 0.5 lbs/acre	Triclopyr 1 lbs/acre	Dicamba 0.3 lbs/acre	Cholpyralid 0.35 lbs/acre	Aminopyralid 0.11 lbs/acre	Fosamine 2 lbs/acre
Huzzah Creek	071401020408	84	62	78	11	23	18	8	2	78
Indian Creek	110100060104	1,528	1,277	1,200	126	748	383	411	74	195
Indian Creek-Black River	110100070703	4	4	8			1			
James Branch-Huzzah Creek	071401020403	164	149	238	7	15	45	10	3	100
Leatherwood Creek-St Francis River	080202020406	364	358	715	3	364	107			
Little Barren Creek	110100080607	57	13	26	22	44	4			26
Little Beaver Creek	110100030207	49			24	49				
Little Creek-Little North Fork White River	110100030601	150	47	40	52	105	14	10	3	35
Little Hurricane Creek-Eleven Point River	110100110210	1,036	830	1,659	92	184	249	8	2	178
Little Pike Creek	110100080402	76			38	76				
Long Creek-Beaver Creek	110100030212	1			0	1				
Lost Creek-Courtois Creek	071401020304	3,514	3,514	7,028			1,054			
Lower Hurricane Creek	110100110209	93	12	23	41	81	3			12
Lower Pike Creek	110100080404	50			25	50				
Lower Spring Creek	110100110205	43								86
Lower West Fork Black River	110100070104	35	29	59	3	6	9			59
Marble Creek	080202020401	237	228	455	5	237	68			
Marler Branch-Otter Creek	080202020504	0						0	0	
Middle Bull Creek	110100030107	18	17	34	1	1	5			34
Middle Hurricane Creek	110100110208	130	0	1	65	130	0	0	0	

HU NAME	HUC	Total Infestation for all NNIPs	2,4-D 1 lbs/ac	Glyphosate 2 lbs/acre	Fluroxypyr 0.5 lbs/acre	Triclopyr 1 lbs/acre	Dicamba 0.3 lbs/acre	Cholpyralid 0.35 lbs/acre	Aminopyralid 0.11 lbs/acre	Fosamine 2 lbs/acre
Middle Pike Creek	110100080403	3			2	3				
Middle Spring Creek	110100110204	163	146	179	8	17	44	20	6	179
Middle West Fork Black River	110100070103	336	109	155	114	228	33	11	4	154
Mill Creek	102902030107	61	34	0		0	10	12	4	53
Mill Creek-Roubidoux Creek	102902010503	19	4	7	7	19	1			
Millers Creek-Cedar Creek	103001021003	68			34	68				
Mooney Branch-Big Piney River	102902020401	39	34	68	3	39	10			
Noblett Creek	110100060105	272	115	65	75	159	34	34	10	
North Fork Buffalo Creek	110100080608	70	11	22	30	59	3			22
Pine Creek	110100080201	79	79	94		47	24	27	3	
Piney Creek	110100020601	0	0	1	0	0	0			
Pond Fork	110100030604	502	239	188	132	263	72	51	16	188
Prairie Creek-Gasconade River	102902010408	4			2	4				
Prairie Fork-Middle River	103001021401	27			14	27				
Roaring River-Table Rock Lake	110100010805	48	17	34	15	48	5	0	0	
Rock Creek-Roubidoux Creek	102902010505	5			3	5				
Rock Creek-Table Rock Lake	110100010807	586	578	959	3	448	172	189	11	74
Rockhouse Creek	110100020406	11	9	16	1	11	3	3	0	
Roller Hollow-Beaver Creek	110100030210	67	27	23	20	40	8	6	2	23
Rush Creek-Eleven Point River	110100110307	74	48	96	13	26	14	0	0	23

HU NAME	HUC	Total Infestation for all NNIPs	2,4-D 1 lbs/ac	Glyphosate 2 lbs/acre	Fluroxypyr 0.5 lbs/acre	Triclopyr 1 lbs/acre	Dicamba 0.3 lbs/acre	Cholpyralid 0.35 lbs/acre	Aminopyralid 0.11 lbs/acre	Fosamine 2 lbs/acre
Shoal Creek	110100030703	165	106	213	29	165	32	37		
Sinking Creek	110100080303	94	39	77	28	56	12			77
South Fork Buffalo Creek	110100080609	25			13	25				
Spring Creek	102902020303	98	81	161	9	17	24			161
Spring Creek	110100060109	389	220	393	83	182	66	14	3	272
Strother Creek	110100070301	9			5	9				
Sunnen Lake-Fourche a Renault	071401040202	639	639	1,278			192			
Table Rock Lake-James River	110100020603	0	0	1		0	0			
Tabor Creek	110100060108	643	425	752	109	218	128	17	5	45
Tenmile Creek	110100070903	1								
Turkey Creek-St Francis River	080202020210	3	3	5		3				
Upper Bull Creek	110100030105	42	31	50	5	11	9	2	1	50
Upper Hurricane Creek	110100110207	391	268	432	61	123	80	18	6	432
Upper Pike Creek	110100080401	28	5	6	12	23	1	1	0	4
Upper West Fork Black River	110100070101	209	60	101	74	148	18	3	1	101
Wells Creek-Current River	110100080901	70	32	64	10	19	10	7	2	
West Fork Big Creek	110100030705	272	43	10	115	229	13	13	4	10
West Fork Fourche River	110100090101	14	2	4	6	12	1			
Whites Creek-Eleven Point River	110100110301	143	18	35	51	102	5	8	3	22
Widow Creek-Black River	110100070702	368	264	512	10	188	77	88	9	38
Williams Creek-Black River	110100070701	2,895	2,877	5,641		2,094	846	739	2	

HU NAME	HUC	Total Infestation for all NNIPs	2,4-D 1 lbs/ac	Glyphosate 2 lbs/acre	Fluroxypyr 0.5 lbs/acre	Triclopyr 1 lbs/acre	Dicamba 0.3 lbs/acre	Cholpyralid 0.35 lbs/acre	Aminopyralid 0.11 lbs/acre	Fosamine 2 lbs/acre
Zachs Branch-North Fork River	110100060110	242	132	80	55	110	40	32	10	33
Total		**41,789**	**34,131**	**37,725**	**3,358**	**12,171**	**10,115**	**6,780**	**1,700**	**6,402**

APPENDIX G – RESPONSE TO COMMENTS

The Draft EIS was made available for the official 45-day public review and comment period, which ended August 8, 2011. Nine letters were received in response to our solicitation for review and comment. One commenter (#6) asked for a link to the EIS, but never sent any comments.

1. Jim Bensman, Missouri Forest Alliance
2. Robert Kandace Rich
3. David Schilling
4. Becky Denney
5. Sara Vanderfeltz, Missouri Federal Assistance Clearinghouse
6. Dick Artley
7. Kent Collier, Kickapoo Tribe of Oklahoma
8. Robert F. Stewart, Regional Environmental Coordinator, US Department of Interior
9. Robert Hammerschmidt, Ph.D., Environmental Services, Environmental Protection Agency

Responses to Public Concerns

Public Concern 1:

The Forest Service needs to complete a Forest Plan amendment for the proposed action.

Response: Commenter contends a Forest Plan amendment is necessary because the control methods described in the proposed action constitute management policy and additional guidance, which must legally be part of the Forest Plan. The commenter bases his argument on a court case in which the Daniel Boone National Forest was using three documents containing various policies and strategies in addition to the Forest Plan to guide its management. Plaintiffs in the case argued that it is illegal to have more than one plan, and that the three documents were actually amendments to the Forest Plan that had been developed and implemented without any public review and comment. The Forest Service argued that the documents merely clarified direction in the Forest Plan. The Court found that "the three policies provide additional guidelines, and as such are subject to the notice and comment procedures set forth in NFMA and NEPA. Accordingly, the Court finds that these policies may not be implemented until the Forest Plan has been properly amended to include the same." House v. United States Forest Service, 974 F.Supp. 1022, 1034 (E.D. Ky. 1997).

The NNIP project is distinguishable from the Daniel Boone case in several key respects. First, under the NNIP proposed action, areas of infestation to be treated and acceptable treatment methods are specifically identified and analyzed. The NNIP project is an independent, site specific action that does not govern other ongoing or future actions on the Forest. The NNIP control methods and design criteria, which are part of the proposed action, apply only to treatments authorized under the decision for this project. Unlike the Daniel Boone policies at issue in House, the treatments, mitigation, monitoring and other aspects of the NNIP project do not provide programmatic direction or policy for future project decisions. The project is consistent with the standards and guidelines of the Mark Twain National Forest Plan and does not supplement plan direction like the Daniel Boone National Forest policies and strategies in House. Since this is a site-specific decision and the design criteria apply only to the treatments authorized by this decision, a forest plan amendment is not required.

This project is also different from the Daniel Boone case because the design criteria included in the proposed action were subject to notice and comment components as part of the project's Environmental Impact Statement in compliance with NFMA and NEPA. The lack of notice and comment on the policies in question in the Daniel Boone case were the central focus of the Kentucky Court's adverse ruling in House v. Forest Service. The policies and strategies at issue in House stood apart from the Forest plan and project documents. Unlike the Daniel Boone policies, the NNIP proposed action, mitigation, monitoring, and other project components have been reviewed by the public during the scope and formal public comment phases of project development. We have sought public input and listened to the comments received on the draft EIS. We appreciate the time taken by many to consider our proposal and have made changes to the EIS as a result.

The commenter also contends that a Forest Plan amendment is needed to change the guideline not allowing cattle for NNIP control. The Forest Plan (page 2-2) states: "Grazing of livestock other than cattle and horses may be used for biological control of NNIS." This statement, although ambiguous, does not prohibit cattle as a means for controlling NNIP. The statement is meant to be inclusive of livestock other than cattle and horses, such as goats. As the commenter points out and as described in the record, the Mark Twain NF has used cattle grazing as a method of NNIP control in the past. The plan was not intended to end the longstanding practice of using cattle or horses on the Forest for NNIS control, but rather to allow local land managers the flexibility to use grazing animals other than horses and cattle to accomplished desired management objectives regarding invasive plants. The statement has consistently been interpreted by the Forest as allowing grazing of livestock for biological control of NNIS.

The commenter also contends that the Forest Plan must be amended to "include S&Gs for each invasive species to be treated." He quotes the NFMA implementing regulations used in Forest Plan revision (36 CFR 219 (1982)), which require that "[t]he vegetation management practices chosen for each vegetation type and circumstance shall be defined in the forest plan with applicable standards and guidelines and the reasons for the choices." The 1982 NFMA regulations envision programmatic standards and guidelines for "each vegetation type," not each species as stated by the commenter. The Forest Plan does includes Forestwide standards and guidelines for NNIS management on page 2-2 and for pesticide use (including herbicide) on page 2-20, as well as direction specific to various resources and management areas (*see* Forest Plan, Appendix B.) The Forest Plan complies with the regulatory requirements cited by the commenter. As discussed above, the proposed action for this project does not include design criteria to be used as Forest-wide direction for future project decisions; the mitigation measures set forth in the proposed action apply only to the site specific activities authorized by this decision.

As discussed in Chapter 2 under "Alternatives Considered by Eliminated," an alternative to include the design criteria as an amendment to the Forest Plan (for future application to other site specific actions) was considered but eliminated from detailed consideration in the analysis. This NNIP EIS considers specific actions on specific conditions throughout the Mark Twain National Forest. Through site specific analysis, we developed mitigations (project design criteria) to mitigate potential adverse impacts from these localized NNIP treatment actions. Based on the public comments received, we again considered whether a Forest Plan amendment was necessary and determined that it was not, for the reasons noted above. The record also documents our determination that the project is consistent with the Forest Plan and appropriately incorporated the programmatic EIS by reference. It was unnecessary to prepare a Forest Plan amendment or supplemental programmatic EIS because the proposed action authorized only site specific NNIP treatment actions at particular locations.

Public Concern 2

An alternative that should promulgate Categorical Exclusion authority to treat NNIS should be considered.

> …(T)he DEIS proposes an illegal rule, the DEIS refuses to consider following the requirements of APA and CEQ Regulations to create a legal rule.
>
> To treat these NNIPs, the Forest Service must either 1) Prepare an EIS or EA that contain a site specific analysis of effects; or 2) use a CE. When a CE is used, NEPA only requires the agency to make sure the action is in the category and deal with extraordinary circumstances. When a CE is used, the agency is not required to address the site specific effects because the rulemaking found there would be no individual or cumulative significant effects from the category. It is plain as day that the Forest Service wants to avoid having to do a site specific analysis of effects for each infestation. We agree NNIP cannot be effectively dealt with if a site specific analysis of effects is required before anything is done. This is why we have been pushing for rulemaking.
>
> We appreciate the fact that the Mark Twain (and at least the Shawnee) has asked the WO to start rulemaking for NNIS CEs. If the Mark Twain complied with NEPA, developed the rulemaking alternative, and compared it to using site specific EAs and EISs, it would clearly demonstrate the urgent need for the Forest Service to create NNIS CEs. Then the Mark Twain could present the EIS to the Chief. If the Chief is truly committed to fighting NNIS, we believe based on the EIS he would choose rulemaking. As the DEIS points out, the Chief has to make the call. So its time for the Mark Twain to prepare an EIS that presents the issue to the Chief."

Response: As stated in the EIS, page 25, the authority to create a categorical exclusion from documentation in an EA or EIS is not within the Forest Supervisor's delegation. According to FSM 1950.43, the Director of Ecosystem Management Coordination in the Washington Office has the authority for development of "Forest Service compliance policy and procedures." At the commenter's request, the Mark Twain Forest Supervisor forwarded the commenter's proposal for a new categorical exclusion to the Regional and Washington Offices, but the agency has chosen not to pursue a new categorical exclusion at this time. It may be that in the future the agency undertakes the process for developing a new national categorical exclusion regarding invasive species In the meantime, NNIP on the Forest continue to spread and threaten our native ecosystems. The immediate threat to local resources is set forth in the record, especially the EIS' statement of purpose and need. Based on the best available science, public comment, as well as the surveys and analysis prepared by local resource specialists described in the record, the Forest Supervisor has chosen to focus on site specific action within his authority in order to take steps now to begin to address the local NNIP threat.

Public Concern 3

Additional analysis beyond this EIS is required for treatment of unmapped NNIP infestations.

> "It is also important to understand the proposed action is to 1) illegally treat specific NNIP infestations without any analysis of site-specific effects; and 2) create this illegal rule, "Unmapped NNIP infestations would be treated similarly with regard to treatment objectives." DEIS at 13. …
>
> To treat these NNIPs, the Forest Service must either 1) Prepare an EIS or EA that contain a site specific analysis of effects; or 2) use a CE. … When a CE is used, the agency is not required to address the site specific effects because the rulemaking found there would be no individual or cumulative significant effects from the category. It is plain as day that the Forest Service wants to avoid having to do a site specific analysis of effects for each infestation. …

Response: The commenter incorrectly asserts that, in the absence of a categorical exclusion for treating invasive plant species, NEPA requires a separate analysis for each specific piece of ground proposed for treatment. The comment seeks a level of analysis not required by law. NEPA requires an appropriate level of analysis to avoid or mitigate significant adverse effects and to provide the decision-maker sufficient information to make an informed decision and allow for public scrutiny. NEPA requires a hard look at the potential direct, indirect and cumulative effects of the alternatives to the proposed action. There is no requirement in NEPA or its regulations mandating analysis or data at a particular spatial scale, nor does NEPA prescribe any particular methodology for analyzing or disclosing environmental effects. NEPA requires a hard look at effects, and the detailed site specific disclosure set forth in the analysis and project record complies with that requirement.

The NNIP is a site specific proposal to treat invasive plants at identified geographic locations across the 1.4 million acre National Forest. The analysis uses on-the-ground survey information from known NNIP sites, and other existing local surveys, data sources, and databases to determine possible alternative treatments and potential adverse effects. Both Forest Service and non-agency data were compiled and used for this EIS. The most site specific information available was used by the local resource experts to prepare this analysis. No other sources of information are identified by the comment. Although it is always possible to create more data and more analysis at different scales, the Forest interdisciplinary team obtained the data and survey information appropriate to allow for an informed decision. The scientific information compiled for this study was analyzed in the specialist reports and organized into the project record.

The NNIP EIS analysis discloses the potential effects of the alternatives so the public and decision-maker can understand the environmental consequences. Throughout the process, the public has been informed of the proposed treatments and the areas to be treated, which includes mapped and unmapped infestations within specifically identified, well-defined geographic areas. The EIS analyzes the environmental impacts of the suite of treatment methods applied to site-specific geographic areas within the project area. Known NNIP populations have been mapped and assigned a treatment objective and method(s). Environmental effects are disclosed in the Environmental Consequences section of the EIS. The effects disclosure is tied to particular sites, local resources and on-the-ground surveys. Local resource experts familiar with the conditions and areas involved in this proposal conducted the analysis and documented their findings in the EIS. Design criteria and mitigation measures for specific conditions were developed to reduce or eliminate potential adverse environmental impacts. Based upon on-the-ground surveys, monitoring data, past experience and review of scientific literature, no significant adverse impacts were identified. There is no evidence that additional site specific information is necessary to inform the decision-maker or the public of the potential impacts of the proposed treatments. If a situation arises where the impacts have not previously been disclosed, appropriate NEPA analysis will occur at that time.

Public Concern 4

The Forest Service should treat NNIP species as proposed in Alternative 2.

Response: Thank you for your support.

Public Concern 5

The use of three bio-agents proposed for the control of spotted knapweed should be monitored for impacts to non-target species

Response: The Mark Twain National Forest will work in cooperation with the Missouri Department of Conservation and the University of Missouri Extension to monitor impacts to non-target plant species when releases occur on and adjacent to the Forest. The State has released root and seed head weevils at over 200 locations across the State and is conducting monitoring on many of these sites. At this time, there have been no documented occurrences of these specific bioagents impacting non-target plant species. This is also true to the upper Midwest and the Pacific and Intermountain West where these bioagent have been in use for spotted knapweed control for several years.

Public Concern 6

The Draft EIS could be strengthened in numerous places with editorial changes.

Response: Thank you for your thorough review. Editorial changes have been made in the document.

Public Concern 7

The DEIS lacks a comprehensive and organized discussion of past, current, and future land management practices within the MTNF that could influence the risk of both the introduction and expansion of NNIP.

Response: In response to public comments and agency review of the DEIS, additional information has been added to the FEIS to clarify the information presented concerning past, current, and future land management practices. Further information in the record available to the public supports the FEIS discussion. With this clarification, we believe the FEIS contains comprehensive, well-organized and detailed information about past, present, and future management practices and their relationship to the introduction and expansion of NNIP. (EIS, Existing condition, p 3-4, and Other Related Efforts, p 8-10, p 50, and throughout the cumulative effects analyses for each resource). We have also reviewed the cumulative effects information set forth in the programmatic EIS prepared for the revised and 1986 forest plans as well as monitoring reports and have incorporated it by reference into this analysis. In summary, the record contains the best available information on past, present, and reasonable foreseeable actions that might affect NNIP. We have used all of the information submitted to us by the public and others on the cumulative effects issue, and note that this comment does not present any site specific cumulative effects information that was overlooked or ignored.

The information set forth in the FEIS indicates that the Forest Service performs a variety of land management practices, such as road construction and maintenance, timber harvest, prescribed fire, livestock grazing, and many other ground disturbing activities that can contribute to the spread of invasive plant species. In addition, the Forest allows a variety of dispersed recreational activities such as conventional vehicle and ATV use, horseback riding and hiking that also can contribute to the spread of invasive species. Recognizing that ours and others' site specific activities on the Forest may affect NNIP, the Forest Service follows several best management practices designed to reduce the spread of invasive species. For example, the Mark Twain National Forest requires that all timber harvesting contractors wash their trucks, skidder, and other equipment before moving from one timber sale area to another to reduce the spread of seed.

The Forest has taken a hard look at site specific cumulative effects. We defined the bounds in time and space for the analysis, and documented the reasons for those determinations. The Forest has made a reasonable effort to compile information concerning past, present, and reasonably foreseeable future actions on private lands that affect NNIP populations on or adjacent to the Forest. Likewise, the Forest has sought for information concerning treatments (especially herbicide use) on private lands that are relevant to this analysis. We consulted with other government and private resource experts and researched different treatment methods and unintended consequences to ensure that this analysis was based on the best available science. The interdisciplinary team paid particular attention to the NNIP efforts of the State and other similarly situated public lands. The analysis set forth in the FEIS is not a mere listing of actions, but rather a thoughtful, detailed consideration of site specific cumulative effects in the context of the overall programmatic analysis set forth in the Forest Plan EIS. The FEIS is well-grounded in science (as documented in the record) and informed by public input. Although it is always possible to include more information and describe further detail, the FEIS presents a hard look at cumulative effects and informs both the Responsible Official and the public as to the treatments and mitigation as well as the incremental impact of those treatments with regard to other actions.

FSM 2900, Invasive Species Management, sets forth national Forest System policy, responsibilities, and direction for the prevention, detection, control, and restoration of effects from aquatic and terrestrial invasive species (including vertebrates, invertebrates, plants, and pathogens). All NFS invasive species management activities will be conducted within the following strategic objectives: 1) Prevention 2) Early detection & rapid response 3) Control & management 4) Restoration 5) Organizational collaboration.

Public Concern 8

The DEIS lasts sufficient information supporting decisions regarding the most effective method or combination of methods for NNIP treatment and eradication across the variety of land forms and soils in the MTNF.

There is a great deal of material within the DEIS which could be presented more effectively using mapping tools.

Chapter 2 references such resources as being available on the MTNF website, but the absence of any such displays or information within the DEIS hampers the review of the document.

Response: We respectfully disagree with commenter's assessment that the EIS lacks sufficient information on the most effective methods for treatment.

The rationale used to assess the methods of treatment is documented in Chapter 2 of the FEIS, and MTNF NNIP Treatment Methods document, located on our website, and incorporated by reference. (The treatment methods document was available for public review along with the NNIP DEIS.) Treatment methods vary by site-specific factors such as infestation type, treatment objectives, and the timing of treatment. Other site specific factors such as soil physical and chemical properties and landscape position were considered when developing mitigations for treatments. The WIN-PST 3 model was used to compare interactions between the proposed herbicides, application methods, and all soil types on the MTNF. The data and modeling limitations and presumptions are set forth in detail in the record and were available for public review. Infestations on soils with high leaching potential due to slope, texture, depth to water, low organic matter, or proximity to water would be treated according to the MTNF LMP and project design criteria. Further, soil physical properties and landscape position would receive the same consideration when selecting treatments that cause soil disturbances.

We appreciate the comment's suggestion that some material within the DEIS could have been presented more effectively using mapping tools. A large number of maps and illustrations are included in the record to communicate effectively the nature of the current NNIP threat on the Forest and assist the reader in understanding the complexity of the issues involved. Site specific factors are key to understanding the treatment method efficacy, but a comprehensive, Forest-wide effort is needed to make a difference. This is shown by our monitoring information and the limited effectiveness of past, individualized attempts to reduce or control NNIP. Mapping tools were used to inform the public and Responsible Official about the location and potential effects of particular treatments in specific areas. The sophistication and thoroughness of the comments indicates that the maps and information presented in the DEIS was sufficient to allow the public to review and comment upon the draft document. This proposal is scientifically complex and involves technical issues concerning evolving methods of treatments and their efficacy and impacts. The Forest has devoted much effort to ensuring that the best available science has been used to inform this analysis, especially with regard to the choice of treatments and cumulative effects. We have endeavored to present this information in the EIS at the appropriate level of detail so that the reader can both understand and appreciate the difficulty presented by NNIP across the Forest and on much of the adjacent ownership. The interdisciplinary team worked hard to ensure that the trade-offs between alternatives, especially with regard to taking no action concerning NNIP at this time, was clearly presented so that the public and Responsible Official were well-informed. Maps and mapping tools were a key part of this effort. We are sensitive to the scientific and technical aspects to this proposal and believe that the information presented is balanced and complete.

Public Concern 9

The DEIS lacks sufficient presentation of the potential for impacts to sensitive or vulnerable water resources from sediment and herbicide runoff potentially arising from the implementation of control methods.

> There is an adequate amount of toxicity data related to the herbicides proposed for use under the preferred alternative, but no characterization of aquatic resource within the MTNF or adjacent waters under hydrologic influence of MTNF waters. The DEIS would be greatly improved if MTNF surface waters and connected neighboring waters were mapped and described as to federal or state protective designations and unique ecological features. This inventory and mapping would include wetland types, lakes, ponds, cool and cold water streams, and losing streams. In addition, for waters with known water quality problems, the DEIS should identify the cause of those problems and whether the proposed methods of NNIP treatment could exacerbate those water quality problems. This information would identify for the pubic those MTNF resources, which must receive special attention by the Forest Service in the implementation of the project. Specifically, those lakes, ponds, or wetlands, which will be treated for NNIP, should be identified, including the NNIP species being treated and the treatment method considered.

Response: We respectfully disagree with the commenter's assessment that the EIS lacks sufficient information of the potential impacts to water resources. Specific watershed information has been available on the Mark Twain National Forest public website throughout the development of this project, including most of the information the commenter is suggesting we have available. Maps of each known invasive species population were published for the scoping effort. Each population has a treatment objective and method(s). The water resources information in the record is comprehensive, detailed, and site specific. Context information presented in the programmatic EIS prepared for the Forest Plan and other Forest-wide monitoring information was used to inform this site specific analysis and is incorporated by reference.

Potential impacts to sensitive or vulnerable water resources from sediment and herbicide runoff potential were included in the DEIS and described in more detail in the Hydrology, Karst, and Cave Specialist Report. The methodology is summarized in the EIS in Chapter 3 under the Watershed Section on page 59 and explained in further detail in the Specialist Report on pages 16-18.

The Existing Condition for water resources including wetlands, ponds, streams and other water bodies identified in the comment are specifically discussed in the Hydrology Specialist Report on pages 18-27. The direct, indirect, and cumulative effects analysis summary is included in the FEIS on pages 58-69 and in the explained in further detail in the Specialist Report on pages 27-46.

The EIS documented the conclusion that sediment from proposed mechanical treatments and herbicides would not adversely affect water quality through the implementation of best management practices (including BMPs for sensitive or vulnerable water resources) and the Forest Plan Standards and Guides. Forest Plan Standards and Guides are included in Appendix B of the FEIS, and BMPs are included in Chapter 2 under the section "Project Design Criteria" on pages 19-22 of the FEIS. These BMPs have been successfully implemented in a wide variety of projects and have been shown through monitoring to be effective in mitigating sedimentation effects.

The federal and state protective designations including beneficial uses and unique ecological features including wetlands, lakes, ponds, and losing streams have been identified within Mark Twain National Forest Proclamation Boundary and are listed by watershed in the Hydrology, Karst, and Cave Specialist Report Appendixes C and E. GIS data of the locations of information listed in Appendixes C and E are available in the cooperative database and have been used for creating maps for this project. We appreciate the comment's suggestion regarding further mapping and illustration in the EIS, but note that the project record is replete with narrative as well as graphic explanations of the conditions and potential impacts on water resources. The information presented (as well as its format) was prepared or selected specifically by the interdisciplinary team for the purpose of informing the Responsible Official and the public about the nature, location, and potential effects of the proposal. Other publicly available resources contain further mapping and spatial information concerning water resources that may be of more general interest. The mapping in the FEIS and record is specifically included to support the hard look at the impacts associated with this NNIP action. There could always be further maps of various scales created or compiled, but our review based on this comment indicates that the maps in the project record adequately communicate the nature, intent, and effects of this site specific NNIP proposal.

An excerpt from the Hydrology Specialist Report is set forth below in response to the comment and to aid in the understanding of the potential effects of the proposal. The entire Hydrology Specialist Report is included in the record and was available for public review during the formal comment period.

SUMMARY OF CUMULATIVE EFFECTS

Alternative 1 - No Action – Indicator #1 Watershed Condition

- No short-term or long-term adverse cumulative effects from mechanical, cultural, and chemical treatment methods would occur to Waters of the State, Outstanding National and State Resource Waters, Beneficial Uses, Impaired Waters, and Karst Geological Resources.
- No long-term beneficial effects from manual, mechanical, cultural, chemical, and biological treatments methods would occur to Waters of the State, Outstanding National and State Resource Waters, Beneficial Uses, Impaired Waters, and Karst Geological Resources.

Alternative 2 - Proposed Action – Indicator #1 Watershed Condition

- No proposed treatments adversely or beneficially affect impaired waters on the 303(d) list.
- No proposed treatments would cause additional impaired water on the 303(d) list.
- Manual treatments have no short-term or long-term adverse cumulative effects to Waters of the State, Outstanding National and State Resource Waters, Beneficial Uses, Impaired Waters, and Karst Geological Resources. However manual treatments have a long-term beneficial effect to native plants within riparian habitats. These treatment methods do not cause increased sedimentation or add pollutants to streams, waterbodies, or groundwater
- Mechanical treatments – Girdle methods are not a ground disturbing activity or add pollutants to streams, water bodies or groundwater, therefore there are no adverse cumulative effects to Watershed Condition. The additive cumulative effects from sedimentation as a result of cut and

disc treatment methods to Watershed Condition in most HUC-6 are expected to be short-term and immeasurable with the application of Forest Plan standards and guides.

If disc method occurs in areas of unknown soil contamination from windblown deposits from lead and zinc smelter operations, the additive cumulative effects are unknown to Watershed Condition. However, it is expected to minimal compared to the “point source” and not cause the additional listing of impaired water.

- Cultural Treatments –
    - Competition, scorch, and Waipuna® hot foam treatment methods are not a ground disturbing activities or add pollutants to streams, water bodies, or groundwater, therefore there are no adverse cumulative effects to Watershed Condition.
    - Depending on the quantity and concentration of mammals and the soil type, grazing can cause effects to watershed condition. Forest Plan Standards and Guides include best management practices to minimize effects. Grazing proposed solely for NNIP control would most like be only a few animals confined to a small area and moved frequently. In this case, there would be no direct or indirect effects to watershed conditions.
- Chemical Treatments – long-term adverse cumulative effects are not anticipated from the proposed pesticide use on Mark Twain National Forest Lands. If chemical treatment methods are controlled through implementation of Forest Plan standards and guides and BMPs, the potential for project related chemical delivery to the immediate channel and channels downstream would be small. The Forest Plan standards and guides and BMPs provide for more protection beyond the product label requirements. Adverse impacts to Watershed Condition could potentially occur under the following circumstances:
    1. Failure to implement Best Management Practices, Forest Plan Standards and Guidelines, and other required project developed mitigations;
    2. Extreme water yields resulting from abnormally high intensity, magnitude, and duration storm events (discussed under the “Existing Condition” section) before the herbicide breaks down to its half-life; and

  Even if one or all of the above occurs, it is not expected that the proposed use pesticides would create long-term adverse cumulative effects to Watershed Condition. Based on the analysis additional project design criteria is needed to reduce potential effects to Beneficial Uses and Karst Geological Resources:
    - The use of highly mobile pesticides shall be avoided on soils with highly leachable properties where the Soil – Pesticide Interaction, Leaching, Solution Runoff, and Adsorbed Runoff Potential is rated high or extra high. For soils with an intermediate rating, a field visit by the Forest Soil Scientist must be made prior to application.
    - No herbicides will be used within any fen (the fen proper) or hydrologically connected drainage feature unless a "wicking method" is approved by FWS and FS hydrologist. This method should only be used in rare instances.
    - Unless approved by the FWS and the FS hydrologist, no endothall or triclopyr will be used within fens known to contain Hine’s emerald dragonfly larvae or adults or the fen buffer area. The fen buffer area is defined in the Forest Plan as ½ mile upstream of the fen and 300 feet on the lateral sides of perennial streams, that may feed into that fen within ½ miles upstream.
    - No application of herbicides will occur in the Tumbling Creek cavesnail recharge area within 72 hours prior to expected precipitation.
    - Aquatic formulations will only be applied to lakes and ponds

- No adverse cumulative effects to Watershed Condition from proposed biological control treatments.
- All treatments methods are a beneficial cumulative effect to Watershed Condition. Exotic plants are invading and disrupting Missouri natural communities (Nelson 2010). The native plants within riparian habitats could be lost as a result of NNIPs, altering the chemical, physical, and biological components of these habitats.

Alternative 3 - Proposed Action – Indicator #1 Watershed Condition

- Under this alternative, the manual, mechanical, and cultural treatments the cumulative effects are the same as Alternative 2 – Proposed Action.
- The chemical and biological control treatments are the same as Alternative 1 – No Action

APPENDIX H – INDEX

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Per Section 102 (c) of NEPA the following are comments received for the Draft EIS from Federal, State and local agencies.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 7
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

AUG 8 2011

Brian Davidson
Interdisciplinary Team Leader
U.S. Department of Agriculture
Forest Service
Mark Twain National Forest
401 Fairground Road
Rolla, Missouri 65401

RE: Draft Environmental Impact Statement for the Integrated Non-native Invasive Plant Control Project for the Mark Twain National Forest, CEQ #20110189

Dear Mr. Davidson:

The Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for the Integrated Non-native Invasive Plant Control Project (the project). Our review is provided pursuant to the National Environmental Policy Act (NEPA) 42 U.S.C. 4231, Council on Environmental Quality (CEQ) regulations 40 C.F.R. Parts 1500-1508, and Section 309 of the Clean Air Act (CAA). The DEIS was assigned the Council on Environmental Quality (CEQ) number 20110189.

The United States Department of Agriculture, Forest Service (Forest Service) proposes to implement an integrated management strategy to control the spread of non-native invasive plant species (NNIP) within Mark Twain National Forest (MTNF) over the next 10 years or until circumstances change which would affect the validity of the analysis. There are currently 32 species of NNIP currently inventoried by the Forest Service which infest approximately 32,428 acres of the total 1,497,847 acres of MTNF or about 2.2% of managed forest. The MTNF is located in parts of 29 Missouri counties west and southwest of St. Louis, Missouri. The DEIS provides an analysis of the impacts associated with the implementation of an integrated program for the prevention, suppression, reduction and eradication of existing and future NNIP. This analysis considers 3 alternatives, including a no action alternative and two action alternatives which employ an assortment of NNIP control strategies. Control strategies include manual, mechanical, chemical, cultural and biological treatments. Of the two action alternatives, Alternative 2 serves as the Forest Service's preferred alternative and would employ all treatment types, including herbicide treatment on 0.2% of total MTNF acreage. Alternative 3 would utilize all treatment methods except chemical, i.e., no herbicides, and would exclude 3 of the 7 biological control agents proposed.

EPA supports the Forest Service's efforts to prevent the introduction of and control and eradication of NNIP from the MTNF. From our review of the DEIS, the proposed project appears well structured with protective treatment safeguards. However, based on our overall review of the DEIS and the level of our comments, EPA has rated the DEIS for this project EC-2 (Environmental Concerns-Insufficient Information). EPA's detailed comments on aspects of the DEIS and a copy of EPA's rating descriptions are provided as enclosures to this letter. This EC-2 rating focuses on the document itself and is based on the absence of a comprehensive and organized discussion of past, current and future land management practices within the MTNF which could influence the risk of both the introduction and expansion of NNIP, insufficient information supporting decisions regarding the most effective method or combination of methods for NNIP treatment and eradication across the variety of land forms and soils in the MTNF, particularly with regard to herbicides, and the insufficient presentation of the potential for impacts to sensitive or vulnerable water resources from sediment and herbicide runoff potentially arising from the implementation of control methods. In general, the DEIS contains a great deal of information, but is poorly organized and relies too much on references to MTNF websites and other documents to support its analysis in this document. This is particularly true of Chapter 3 which discusses the affected environment and environmental consequences of the project in the context of individual resource components. The combination of analyses of the affected environment and the environmental consequences of the project into one chapter (Chapter 3) might have impaired the clarity and effectiveness of the DEIS. In addition, the document would be improved with the addition of a table or listing of the many acronyms used throughout the summary document and the DEIS.

As reflected in our enclosed issue-specific comments, we suggest that the Final EIS include within its assessment of the affected environment an assessment of past, current and future land management practices within the MTNF which could have contributed to the introduction and spread of NNIP as well as what potential changes to the Forest Service's land management planning could prevent the introduction, expansion or reintroduction of NNIP into the MTNF. In addition, we suggest that the Final EIS include a GIS-based mapping of specific forest units or smaller watersheds within the MTNF for which one method or combination of methods of treatment or removal is best suited using data such as is provided by the NRCS' WIN-PST3 model. Although this model was developed to address the potential for herbicide runoff or leaching, the parameters upon which the model is based could also assist in describing the suitability of different soils and land forms for other methods of NNIP control. Finally, the identification of sensitive aquatic resources within the MTNF and in areas outside of the MTNF boundaries and also waters potentially vulnerable to herbicide runoff or leaching or to runoff from surface disturbance would strengthen the discussion of potential water quality effects. More detailed comments regarding these suggestions are included in an enclosure to this letter.

As the preferred alternative provides for the use of pesticides for the control of NNIP in lakes, ponds and wetlands within the MTNF, please be aware that a National Pollutant Discharge Elimination System (NPDES) permit is now required for discharges to waters of the United States from the application of pesticides. The Missouri Department of Natural Resources (MDNR) is the permitting authority for affected waters within Missouri and should be contacted well in advance of the implementation of the project. Current information on EPA's general permit for discharges from the application of pesticides is available at www.epa.gov/npdes and on MDNR's discharge permitting program at www.dnr.mo.gov/env/wpp/permits/pesticide. The Final EIS should address this new regulatory requirement and describe how the Forest Service will coordinate with the MDNR prior to implementation of the project. Given the 10 year implementation period of this project, we recommend that you regularly monitor the regulatory status of any herbicides used for NNIP control in the MTNF for changes in labeling.

We appreciate the opportunity to provide comments regarding this project. If you have any questions or concerns regarding this letter, please contact Joe Cothern, NEPA Team Leader, at (913) 551-7148 or cothern.joe@epa.gov, or Larry Shepard, NEPA Reviewer, at (913) 551-7441 or shepard.larry@epa.gov.

Sincerely,

Ronald Hammerschmidt, Ph.D.,
Director
Environmental Services Division

Enclosures

U.S. Environmental Protection Agency
Detailed Comments- Integrated Non-native Invasive Plant Control Project Draft EIS

Land Management Practices Contributing to Non-native Plant Species Invasions

The purpose of the proposed project is "to protect and restore naturally functioning native ecosystems on the Forest by controlling current and future threats of NNIP infestations." A comprehensive analysis of past and current land management practices both surrounding and within the MTNF provides the context for the present condition and extent of NNIP infestations in the Forest and the likelihood for success for the proposed project. Without recognition and analysis of the route of NNIP introductions into the MTNF and the management practices which provide for the proliferation of non-native species, the control and eradication of existing populations and the prevention of future infestations could be ineffective.

Non-native species introductions occur frequently throughout almost all native ecosystems. Non-native species become invasive typically in response to both natural and anthropogenic disturbance of or stresses to the native ecosystem, e.g., fire, drought, climate change, species introductions, trails, roadways, forest harvest, recreational uses, air and water pollution. The DEIS should characterize what past, and possibly continuing, disturbances or stresses to the natural forest ecosystem provided the opportunity for non-native species to flourish in the MTNF and how the FS has responded in its management approach. Continuing stress to the ecosystem will impede project success and will limit the project to solely reactive methods. Although Chapter 2 specifically states that "prevention and education are not a part of this NNIP control project because these activities are incorporated into the day-to-day activities of the MTNF" (page 26), the assessment of historic and existing management practices within the MTNF which could have both introduced new infestations and created an environment conducive to expansion of these invaders is critical to the completeness of this DEIS. Although we could not find specific reference to potential sources of introduction or causes of infestation in either the 2005 Forest Plan or its accompanying Final EIS, the Final EIS supporting the NNIP control project should incorporate any pertinent information regarding these issues from these documents into its baseline assessment of NNIP infestation in the MTNF. The DEIS' dismissal of prevention as an important component of this NNIP control project and its only general treatment in the 2005 Forest Plan creates a gap in the ability of this project to fully address the objective of this program which is cited multiple times throughout the document and specifies "***prevention***, eradication, suppression, and reduction of existing and future NNIP infestations …within the Mark Twain National Forest boundaries [**emphasis added**]."

Assessment of Soils and Landforms Suitability

The soils and watersheds descriptions provided in Chapter 3 highlight the diversity of soils and land forms within the MTNF. The DEIS describes thin soils resting on bedrock, thick soil in valleys, loess, gravel, rock fragments, rolling lowlands, deeply dissected uplands, steep slopes, bluff lands, ridge tops and alluvial valleys. The DEIS characterizes the diversity of geology and geography across the MTNF's 1.4 million acres. The wide spectrum of diverse substrate and land forms will affect the utility and effectiveness of control methods. Which control methods are suitable for each location within the MTNF is determined both by the methods themselves and character of the local environment. The Project Design Criteria reflect some of these considerations, but the presentation of these considerations in the DEIS could be made more clear. In general, the DEIS would be greatly improved if it included maps documenting surface features, including land forms, surface waters, roads, trails for motor vehicles, clear cuts, fire sites, old fields and major NNIP infestation locations, which are pertinent to the management of the MTNF and, specifically, to the management of this project. There is a great deal of material within the DEIS which could be presented more effectively using mapping tools.

In general, the DEIS includes no high quality maps and no GIS-based characterizations of the Forest's physical resources nor does it discuss how these resources influence the effectiveness or the environmental suitability of each treatment method. For example, the DEIS states that data generated by the NRCS' WIN-PST3 modeling analysis of soil and herbicide interactions "cannot be easily summarized and displayed in this document." However, a map showing herbicide suitability as well as areas within the MTNF with thin soil cover, shallow depth to groundwater, erodible soils, proximity to surface water or sink holes and sharp relief overlain by areas of extensive NNIP infestation would more effectively communicate to the decision-maker and the public how the FS will implement all components of its control project within each management unit under the provisions of the 2005 Land and Resource Management Plan's Standards and Guidelines and the project's design criteria. Although WIN-PST3 specifically models soil-herbicide interaction, the data entered into this model, in combination with other geographical data, can be mapped and better identify for the decision-maker and the public the basis for determining which control and eradication methods are suited to specific areas within the operational units of the MTNF. Chapter 2 references such resources as being available on the MTNF website, but the absence of any such displays or information within the DEIS hampers the review of the document.

As a minor matter, please verify that one of the soil factors included in the discussion of the WIN-PST3 model should be 'macropores' rather than 'macrospores' in the soil surface horizon.

Water Quality Assessment and Risks to Aquatic Life

There is an adequate amount of toxicity data related to the herbicides proposed for use under the preferred alternative, but no characterization of aquatic resources within the MTNF or adjacent waters under hydrologic influence of MTNF waters. The DEIS would be greatly improved if MTNF surface waters and connected neighboring waters were mapped and described as to federal or state protective designations and unique ecological features. This inventory and mapping would include wetland types, lakes, ponds, cool and cold water streams and losing streams. In addition, for waters with known water quality problems, the DEIS should identify the cause of those problems and whether the proposed methods of NNIP treatment could exacerbate those water quality problems. This information would identify for the public those MTNF resources which must receive special attention by the Forest Service in the implementation of the project. Specifically, those lakes, ponds or wetlands which will be treated for NNIP should be identified, including the NNIP species being treated and the treatment method considered.

Draft Environmental Impact Statement Rating Definitions

Environmental Impact of the Action

"LO" (Lack of Objections)

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

"EC" (Environmental Concerns)

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

"EO" (Environmental Objections)

The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative. EPA intends to work with the lead agency to reduce these impacts.

"EU" (Environmentally Unsatisfactory)

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

"Category 1" (Adequate)

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

"Category 2" (Insufficient Information)

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

"Category 3" (Inadequate)

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Denver Federal Center, Building 67, Room 118
Post Office Box 25007 (D-108)
Denver, Colorado 80225-0007

August 5, 2011

9043.1
ER 11/549

Mr. Dave Wittekiend, Forest Supervisor
US Forest Service
Mark Twain National Forest
401 Fairgrounds Road
Rolla, Missouri 65401

Dear Mr. Davidson:

The Department of Interior has reviewed the June 2011 Draft Environmental Impact Statement (DEIS) for the U.S. Forest Service's Integrated Non-Native Plant Control Project on the Mark Twain National Forest in portions of 29 counties in Missouri, and offers the following comments.

General Comments:

1) We suggest the Draft EIS use scientific names throughout, or include a table of scientific and common names, especially for targeted NNIP species.
2) The Final EIS should include some detail on the minimum level of monitoring to be conducted on non-native plant management actions, and the triggers that will initiate a monitoring effort. This includes monitoring when biological controls are used for non-native plant management, and should address evaluation of the effectiveness of the biological control on the target species and evaluation of the impacts of biological control on non-target species.
3) The Final EIS should clearly document that the proposed herbicides have been shown to have few aquatic and terrestrial non-target effects, when used according to label, and document the difference between non-selective and selective herbicides.

Specific Comments:

Pg. 14, paragraph 2: Define the term "grubbing" which is used frequently throughout the document.

Pg. 31, paragraph 1: The claims about seed dispersal methods may be correct, but would benefit from supporting references.

Pg. 50, Table 7: The table should be expanded to include fate on foliage (e.g. photolytic half-life), soil, groundwater, and surface water (e.g. some light plus hydrolysis). For example, Triclopyr (foliar half-life of 24 h and surface water half-life of 48 h) is overstated. Ester formulations of Triclopyr should not be used unless applied in a bark injection or "cut and paint" application. Under these situations, the chemical rapidly enters the plant but the remainder is photolyzed to the acid form, which is much less toxic to aquatic organisms. The acid form of Triclopyr actually has a registered nuisance aquatic plant label (i.e. safe for fish and invertebrates). Same for 2,4-D acid and imazapyr acid.

Pg. 51, paragraph 2: Substitute "macropores" for "macrospores".

Pg. 78, paragraph 3: The introductory section under "Chemical" could be more specific. An explanation that the approved chemicals present no risk to invertebrates, mammals, birds, or fish would clarify the issue. The text should refer to the risk assessments of the fate and effects of the approved herbicides that were funded by the U.S. Forest Service and conducted by Syracuse Environmental Associates and the U.S. Geological Survey that have confirmed the safety of these chemicals if applied according to label.

Pg. 78, paragraph 4: The text states that Table "9" (actually Table is 12) provides information on the toxicity of herbicides; however, no herbicide toxicity information presented. Both exposure, toxicity, and risk quotients should be directly stated based on a simple published model such as EXAMS, PRZM, or the worst case quotient method used by the USEPA (10ha watershed, 1ha pond, direct overspray) to give a numerical safety quotient of one species such as bluegill or rainbow trout. Refer to publications by Fairchild et al. (provided below) that have applied this under various scenarios and developed graphical representation of safety (Fairchild et al.) based on acute and chronic testing with rainbow trout and the threatened bull trout. This would make a very valuable table for those that are risk-averse.

Pg. 79, Table 12: The risk of 2,4-D to insects and mammals may be overstated. The range of risks quotients appear to be calculated from 2,4-D ester formulations. Acids and salts 2,4-D are lower risk, and the use of ester formulations may not be relevant.

Pg. 79, Table 12: We suggest that each SERA herbicide risk assessments be hot-linked. This would be more user-friendly, and an improvement over the generic link provided in the Appendix.

Pg. 79-82, Table 12: The data on photolytic half-lives of the chemicals are incomplete. For example, the herbicide picloram (not on list) has a photolytic half-life of <24 h when applied to foliage as a spray; however, the soil and water half-life in the absence of sunlight is 300 days. Triclopyr and imazapyr likewise are rapidly degraded by photolysis and now have aquatic labels. Suggest the document provide additional discussion on the herbicide fate characteristics that can be exploited, in a herbicide management plan, to maximize efficacy and reduce non-target risks to biota as well as contamination of groundwater.

Pg. 98, paragraph 3: The text states that "Research suggests there is low risk of bioaccumulation in the food chain from use of the herbicides proposed for use in Alternative 2." We suggest the Final EIS include a reference for this statement.

Pg. 102, paragraph 3: It is unclear why Sericia lespedeza is mentioned specifically. If lespedeza is the only one, that should be made clear.

Pg. 103, paragraph 2: The text should read, "… there is one **known** Mead's milkweed site on the Forest… There is one **known** extant running buffalo clover site… There are two **known** Virginia sneezeweed sites….

Pg. 103, paragraph 5: The text should read, "…thus will not affect the one **known** population of Mead's milkweed on the Forest. There are currently no **known** populations of NNIP near the Mead's milkweed…"

Pg. 104, paragraph 2: The last sentence is unclear. It could mean, "Adverse **effects** from allelopathy are **not** expected"?

Pg. 104, paragraph 3: The paragraph on Chemical Methods indicates that although there are now no known NNIP infestations near the running buffalo clover, these conditions may change. Suggest the document commit to manual removal of NNIP where there is a risk of drift onto TES plants.

Pg. 105, paragraph 3: One species name is omitted; we suggest the document identify the other species dropped from further consideration in addition to Bachman's sparrow.

Pg. 106, Alternative 3: The document should include a discussion on the lower potential for impacts from biological controls due to the fewer number of species used.

Pg. 108, paragraph 1: The switch to prescribed burning is at odds with earlier statements that fire is not used for control of NNIP.

Pg. 118, paragraph 3: The text should read "There are no **known** Virginia sneezeweed sites…"

Pg. 137, paragraph 1: The document states that "there is an abundance of policy and direction…" We suggest the Final EIS include a few examples.

Pg. 142, paragraph 4: The last sentence should be changed to read "Therefore, Alternative 3 is expected to cause slightly more soil disturbance than Alternative 2, but is not expected to increase cumulative disturbance…"

Pg. 159, Invasive Plants and Climate Change: This section be strengthened, with references, or removed. No firm conclusions are drawn and the relationship between climate change, invasive species, and the proposed actions are not clear. As written, this section belongs in the justification section; i.e., we know a few things about climate change-invasive species interactions and here is why we need to act.

Pg. 161, paragraph 2: The text should identify the specific means by which non-native species will adversely affect forest productivity and include references. Reduced recreation, timber production and aesthetic value, are possible examples.

References:

Fairchild, J.F., A. Allert, L.S. Sappington, K.J. Nelson, and J. Valle. 2008. Using accelerated life testing procedures to compare the relative sensitivity of rainbow trout and the federally listed bull trout to three commonly used rangeland herbicides (picloram, 2,4-D, and clopyralid). Environ. Tox. Chem. 27:623-630.

Fairchild, J.F., K.P Feltz, A. Allert, L.S. Sappington, K.J. Nelson, and J. Valle. 2009. An ecological risk assessment of the exposure and effects of picloram to rainbow trout (*Oncorhynhcus mykiss*) and the threatened bull bout (*Salvelinus confluentus*). Arch. Env. Contam. Toxicol. 56:761-769.

Fairchild, J.F., K.P. Feltz, A. Allert, L.S. Sappington, K.J. Nelson, and J. Valle. 2009. An ecological risk assessment of the exposure and effects of 2,4-D acid to rainbow trout (*Oncorhynhcus mykiss*). Arch. Env. Contam. Toxicol. 56: 754-760.

Fairchild, J.F., A.L. Allert, K.P. Feltz, K.J. Nelson, and J. Valle. 2009. An ecological risk assessment of the acute and chronic effects of the herbicide clopyralid to rainbow trout (*Oncorhynhcus mykiss*). Arch. Env. Contam. Toxicol. 57:725-731.

Thank you for the opportunity to review and comment on the DEIS. If you have any questions concerning our comments, please contact Gary LeCain, USGS Coordinator for Environmental Document Reviews, at (303) 236-1475 or at gdlecain@usgs.gov

Sincerely,

Robert F. Stewart

Robert F. Stewart
Regional Environmental Officer

cc: Brian Davidson, Interdisciplinary Team Leader

Kickapoo Tribe of Oklahoma

P.O.Box 70
407 N. Hwy 102
McLoud, Oklahoma 74851

Administration Department
Phone: 405-964-4227; Fax: 405-964-4265
Email: kwilson@kickapootribeofoklahoma.com

July 20, 2011

Mark Twain National Forest
ATTN: Brian Davidson, Integrated NNIP DEIS
401 Fairgrounds Road
Rolla, MO 65401

RE: File Code: 1950-NNIP Infestation

Dear Mr. Davidson:

Thank you for consulting with the Kickapoo Tribe of Oklahoma in regard to the above referenced site(s). At this time, the Kickapoo Tribe of Oklahoma has no objections to the proposed development at the intended site(s). However, in the event burial remains and/or artifacts are discovered during the development or construction process, the Kickapoo Tribe of Oklahoma would ask for immediate notification of such findings.

I consider you to follow your proposed actions for Alternative 2, as long as treatments do not endanger the public or surrounding endangered various species or plants.

Should I be of any further assistance, please contact me at (405) 964-4227.

Sincerely,

Kent Collier
NAGPRA Contact
Kickapoo Tribe of Oklahoma

Cc: NAGPRA Consulting File

Jeremiah W. (Jay) Nixon
Governor

State of Missouri
OFFICE OF ADMINISTRATION
Post Office Box 809
Jefferson City, Missouri 65102
Phone: (573) 751-1851
Fax: (573) 751-1212

Kelvin L. Simmons
Commissioner

July 12, 2011

BRIAN DAVIDSON
MARK TWAIN NATIONAL FOREST
401 FAIRGROUNDS ROAD
ROLLA, MO 65401
COMMENTS-EASTERN-MARK-TWAIN@FS.FED.US

Dear MR DAVIDSON:

Subject **1201032**
Legal Name: MARK TWAIN NATIONAL FOREST
CFDA:
Project Description: THE PURPOSE OF THE PROJECT IS TO PROTECT AND RESTORENATURALLY FUNCTIONING NATIVE ECOSYSTEMS ON THE MARK TWAIN NATIONAL FOREST BY CONTROLLING CURRENT AND FUTURE THREATS OF NNIP INFESTATIONS

The Missouri Federal Assistance Clearinghouse, in cooperation with state and local agencies interested or possibly affected, has completed the review on the above project application.

None of the agencies involved in the review had comments or recommendations to offer at this time. This concludes the Clearinghouse's review.

A copy of this letter is to be attached to the application as evidence of compliance with the State Clearinghouse requirements.

Please be advised that I am the contact for the Federal Funding Clearinghouse. You can send future requests to the following address: Sara VanderFeltz, Federal Funding Clearinghouse, 201 West Capitol, Room 125, and Jefferson City, Missouri 65101.

Sincerely,

Sara VanderFeltz

Sara VanderFeltz
Administrative Assistant

cc: